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Wyoming Oiled Surface Just Opened to Traffic

Wyoming

Low Cost Road Types

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Laid by Road-Mix, Plant-Mix, and Penetration Methods

LACK of road building funds together with a comparatively low traffic density on the major part of its state highway mileage have been the important and compelling factors in a rapid development of intermediate type surfaces in Wyoming. The public demand for something better than a gravel road even where the travel is less than 500 vehicles per day is being met by several types of bituminous treatments, all of which come under a common designation of "Oiled Roads."

The first work in treating gravel surfaces in Wyoming was done in 1924 but with indifferent results due to the grade of oil used. The following two years further experimental sections were built with results that were sufficiently satisfactory to develop methods and materials that would justify a definite program for the future. In 1927 and 1928 80 miles were treated by the "Road Mix" method, 104 miles in 1929 using either Road Mix or Penetration treatments, similarly 127 miles in 1930. In 1931 620 miles have been completed by Road Mix, Penetration and "Plant Mix" methods.

Plant Mix has been used for the first time in Wyoming during the past season, 144 miles being so constructed, and the results have been so satisfactory that this method will be used in the future on all work where both aggregate and bituminous materials are to go on the road at the same time. About 450 miles of Plant Mix will be built in 1932, with 75 miles of the other two types, mostly on local materials that require little or no additional material to give a good oiled surface.

A wide variety of surfacing material has been treated in the 930 miles completed with not a single failure, although some of the mileage has now had four years traffic. Fine blow sands with 18 per cent passing the 200 mesh and all passing the No. 10 have been treated successfully, and through all possible gradations to the best quality crushed limestone. Present specifications for aggregate provide that all shall pass a one-inch circular screen, with not more than 50 per cent passing a No. 3 and not more than 40 per cent passing the No. 10. The amount of 200 mesh should be about 5 per cent. With such a grading the amount of asphalt will *average* 4 to 4.5 per cent on Plant Mix jobs, or will require approximately 1.7 gal. per sq. yd. for a 2½ in. by 20 ft. mat on road mix projects.

The standard section in Wyoming is a 2½ in. oiled mat 20 ft. wide, feathering out in an additional foot on each side. This is placed on a base of gravel or crushed stone of varying thickness, depending on soil capillarity and sub-surface water level, but under ordinary conditions the compacted thickness of the base is 3½ in. and 20 ft. wide.

The grade of oil used in Plant Mix has been a 70 per cent asphaltic oil with viscosity of not over 900 at 122 deg. (Saybold-Furol,) ; in road mix, an oil having not less than 65 per cent asphaltic residue and viscosity of not more that 400 (Saybold-Furol) ; and in penetration work, a 60 per cent asphaltic oil, viscosity not over 250 at 122 deg. (Saybold-Furol.)

It has been found that a heavier oil may be used in the plants because of the heat available necessary to drive off moisture, and on future work an oil having an asphaltic content of not less than 75 per cent will be used. It is desirable to use an oil having an asphaltic content as high as is practicable under the particular

method that may be in use, so that the greatest possible amount of bituminous binder will be incorporated in the road.

The thickness necessarily depends largely on the amount of traffic that is to be carried. If this is sufficient to justify the expense, a three-in. section is to be recommended. However, we have successfully treated a 25 mile section which will not average much more than 2 in. Part of this section has had about 30 months traffic and has stood up well, requiring but very little maintenance. On this particular section the native aggregate of sand and gravel in the grade was utilized, no surfacing material being added.

Any discussion of this type is incomplete without consideration of the thickness and character of the base. Essentially the base should provide sufficient strength to minimize surface failure due to weakness and should perform the further function of minimizing the effect of moisture. The design of the road has a bearing on both of these functions. In Wyoming it has been our standard practice from the beginning to construct what we term an "elevated grade line." By this design the surface of the road has a general elevation above the adjacent ground of one to two feet, thus providing excellent drainage and primarily a snow-free road in the winter. Cuts are kept to a minimum, but where necessary are taken out to the right of way line, thus having a top width of 96 ft. which permits wide, well drained ditches.

A well drained elevated road bed does not require the depth of surfacing that would otherwise be necessary and we have therefore constructed our mixed-in-place surfaces with a total compacted thickness, including base, of four to six inches, with the six in. as standard on heavy or gumbo soils. With the oil mat having a thickness of three inches the base course of gravel, shale or crushed stone, is thus usually three inches. The 25 mile section above mentioned has no base course. Certainly design must be adapted to any particular road and any arbitrary thickness cannot be justified. The design of the surfacing section should be determined by conditions on each project.

The "Road-Mix" method is described briefly as follows:

A compacted thickness of 2½ in. or 3 in. is generally considered desirable in the completed mat. On old roads that are compacted scarifying will be required to a depth of 3 in. This material is then moved into a windrow in the center of the road with a blade grader and observation made to determine that the quantity is uniform. An experienced man will perform this operation very rapidly. In the case of new or resurfacing projects, the top course material can be dumped in the center or at one side shoulder and worked into a uniform windrow with a blade grader. This center windrow is then flattened out with the same blade outfit and is ready to receive the oil applied through a pressure distributor, preferably of 1000 to 1200 gallons capacity. The oil should be applied at a temperature of 120° to 150° F. at the rate of 0.5 gal. per sq. yd. Following the distributor is a tractor and disc harrow which operates continuously until all the oil is applied. The oil is applied in three applications of 0.5 gal. each (approximately 1.5 gal. total) or the exact amount that has been determined to be necessary for the aggregate being. treated. Following the application of all the oil the material is again bladed into one windrow and then mixed or processed by blading back and forth across the road until every particle is coated with oil and the entire mass is a uniform color; when it is ready to lay down and receive traffic. After the material is laid down traffic should be turned over it and then maintained for a few days with a blade or multiple blade until it has taken its final shape and set. The result is the smoothest riding surface that can be built.

Costs.—The general average of costs on road mix jobs has been approximately $1750 per mile, not including aggregate.

Plant Mix—Complete Crushing, Screening and Oil Mixing Plant

The cost of penetration treatment on a well compacted gravel or crushed stone surface will vary from $830 to $1300 per mile.

The average contract price in 1931 on 144 miles of plant-mix was $1.669 per ton, exclusive of the cost of

Road Mix—Turning Entire Windrow Each Trip Over Project

oil which was furnished by the state at an additional cost of about $700 per mile.

Maintenance costs on records to date indicate an average of $275 per mile for the treated surface, while the cost of maintaining untreated gravel roads during the same period has been $313 per mile.

The replacement cost of gravel is $300 per mile per year, so that the total annual saving in maintenance cost is $338 per mile.

Another development in the use of asphaltic oil is the Penetration Method, which is adapted to crushed stone or gravel surfaces that have been tightly bound up under traffic. On such a project the surface is swept clean with a power broom and oil applied to the clean surface at the rate of about 0.6 gal. per sq. yd. in two applications.

The fact that gravel losses are practically eliminated, while at the same time a smooth, dustless surface is provided, certainly justifies the existence and continuance of this type of surface.

Methods and materials as well as specifications should be adapted to meet conditions as they exist on various projects or sections of road. Too narrow a specification on bituminous material may not correspond with sources of supply, and an arbitrary design may be uneconomical for the traffic and prevent the use of local materials that are really suitable.

Our experience in Wyoming amply justifies the program of 1900 miles and we are strongly of the opinion that our adjoining states might well adopt this type of improvement for large mileages and thus provides their people with the dustless, mudless surface that is the smoothest riding surface that can be built and which is so well adapted through low cost, where funds are limited, to provide the highway for high speed that is now generally demanded and expected by the motoring public.

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Rolled Metal Curb For Park Roadways

DRIVEWAYS and roadways in Genesee Valley Park began raveling badly along the edges and the surface needed a smoothing treatment. After analyzing the cost of improving these by various methods, it was decided to use Metalcurb. The roadways had been previously constructed of asphalt. This, we believe, is an ideal, efficient, and inexpensive method of improvement.

In one location the road crossed a depression on an embankment immediately after leaving a through-highway. We determined on the use of Metalcurb to maintain a clearly defined roadway limit in the interest of safety and of maintenance costs. On this work, the curb plates were placed so as to be flush with the top of the road surface at the edge of road.

This road was constructed of 8 in. of limestone, rolled to 6 in. and properly filled with limestone dust. On top of this base were laid 2 in. of non-skid stone-filled asphalt made at our municipal asphalt plant. Due to the lateness of the arrival of the curb, it was necessary for us to disturb the base so as to place the tie-rods for the curb but so that there would be no depressions in the road, we refilled these cuts with the same asphalt as appears on the top of our base, thus assuring

Preparing Genesee Valley Park Roadways with Metalcurb for the Retention of Asphalt Surfacing. Tie-Rods Are Placed in Channels Dug Across the Road

ourselves that we will never have to worry about any deterioration to our material.

We also filled between the shoulder and the curb, properly tamping with the same asphaltic material.

Where the roadway was straight, the curbs were placed 18 ft. apart and held on parallel alignment by means of tie-rods. The tie-rods, placed through holes punched midway on width (height) of curb, fitted at one end with a 2-in., 90-deg. bend and at the opposite end with 3 in. of "threads" equipped with two nuts. One nut was for the outside of the plates and one nut for the inside, for adjustments.

The curved intersections were easily taken care of by use of 10-ft. length rods placed in the roadway on radial

Channels for Tie-Rods Are Filled Before Surfacing Is Applied

lines which passed through the holes, 6½ ft. c. to c., punched in the curb-plates. These 10-ft. rods were fitted with a 1¼-in. eye at one end, instead of the 2-in., 90-deg. bend. Through the eyes we drove 15-in. stakes, 1 in. in diameter. The larger radius was 90 ft. and the shorter 35 ft. The tops of all stakes and all rods are

a minimum distance of 3 in. below the finished road surface.

On this job, in Genesee Valley Park, we installed the base course first and dug narrow trenches at the side of the road for the curb plates, also narrow cross-trenches through the 2-in. crown of the base course for the rods. Later on a third installation in Seneca Park, we installed the curb plates first and we believe there is an advantage in the latter type of construction.

The cost installed, of over 500 ft., in Genesee Valley Park was 50 cts. per lin. ft. of curb. But on the Seneca

The Completed Roadway in Genesee Valley Park

Park job this was cut to 45 cts. per lin. ft. Allowing for varying conditions, the cost to install, exclusive of material, will run from 15 cts. to 25 cts. per lin. ft. of curb.

The manufacturer has employed the rocker arm principle, i.e., the tie-rod is fastened near the mid-point of the curb, with the base beneath and the new surfacing above. As outward pressures bear on the upper portion of the curb, during construction of the new surface and later from the side thrust of traffic, the tie-rods hold the curb at the rocker point so that equal and opposite pressures bear on the old road-bed. The tie-rod, in effect, causes the pressure against the upper part of the curb to be transferred through the curb to the solid base of the old road.

Tree at Entrance to Mt. Hope Cemetery, Rochester, N. Y., Which Was Encroached on in Parking Cars

Our experience on three separate installations has proved the advantageous. The several designs of tie-rods, of which we used two, are simple and they provide for easy installation with a minimum of time and labor. No special equipment is required. We used the standard lengths, 20-ft.; they were 6 in. wide and ¼ in. thick. Holes were punched for ½-in. tie-rods, 3 in. from each end and then 6½ ft. apart. We have learned that any variation from these standard dimensions may be obtained.

Our first use of the product was to protect a valuable tree in a large cemetery. Three narrow driveways converged at this spot and vehicles frequently drove on to the grass close by the tree. To prevent this damage, we enclosed the tree with Metalcurb, allowing curb to project 2 in. above the asphalt driveway. A quarter-round edge on the top part of the curb prevents the cutting of auto tires when they may rub against curb. The curbing is very flexible, for horizontal bends, and was curved on a 6-ft. radius with the center of tree slightly off of the radius point.

After Placing Metalcurb a Good Quality of Soil Was Kept Loose for the Tree

To hold the curb in place, the manufacturer provided small openings for ½-in. steel stakes on the inside of the curb plates, placed 16 in. apart. These openings were made of 1-in. wide strips of 8-gage metal cut into 4-in. lengths, shaped as the letter U with top of letter bent outward at a 90-deg. angle to provide a flat surface which was spot-welded on the inside of the curb plates. We drove steel stakes, each 15 in. long, through the openings. The top of the stakes bent over 1 in., at 90-deg. angle, so the curb could not rise unless the stake was pulled out. Perhaps this is not the usual use for Metalcurb, but it proves the adaptability of the product to unusual situations.

Geometry a Brain Stretcher

Geometry is a universal preparatory requirement for technical courses. Many of the propositions are of every-day usefulness. The rest, and the logical system of reasoning involved, are necessary for the development of the geometric sense which enables the student or the engineer to translate drawings into ideas and vice versa. It is the foundation for descriptive geometry, probably the most important of the fundamental technical courses, and of all work involving graphical methods—a large field. No student should be satisfied with a half-baked knowledge of "descrip." However, once having gained a real mastery of the subject, he should not be discouraged if he cannot readily recall the solution of particular problems.

Political Piracy *on Gas Tax Revenues UNJUSTIFIABLE*

Diversion a Menace to Future Construction and Retirement of Present Bond Issues

RATIONAL, non-political, unbiased, engineering investigation into contemporary practice of financing street and highway improvements will disclose factors that have a controlling effect in the equitable assessment of highway costs. The facts themselves vary slightly from place to place and from state to state but the methods of attack upon the problem result in a uniformity of procedure. From such investigations on this subject as have been made in all parts of the United States, according to Roy W. Cram, Director of the Highway Research Board, National Research Council, there is evidence of concurrence in the following principles:

1. Motor vehicle users should pay a fee to cover what is called, in public utility parlance, "readiness-to-serve." This may be considered to represent the motorist's contribution to the capital investment, and is generally collected through license fees.

2. Motor vehicle users should also pay some amount based upon their use of the roads. This amount may represent their share of the operating costs of the highways, and is universally collected at the present time through imposts on gasoline.

3. No part of the funds raised by means of motor vehicle license fees or gasoline taxes should be diverted to any other use than the construction, maintenance, and control of highways.

As stated before, these three general principles indicate a basis for policy for equitable assessment of highway costs and they represent the views of clear thinking taxpayers.

If politicians need funds for other reasons than road work and are incapable of analyzing their problems so as to determine the proper, justifiable source of the revenue, then they should call for expert unbiased advice and be guided by the recommendations of the advisory board. Raiding the gas tax revenues for funds other than highway work is an admission on their part that they do not understand the subject of political economy; a subject in which they profess to be proficient by the very act of their requesting votes for public office.

When the motoring public was presented with problem of financing roads on which to drive their cars they agreeably accepted the gas tax as a fair measure of highway use. In general, this tax, more effectively than any other single method, meters highway service to the motor vehicle operator.

Funds for other purposes should be measured or metered by a method that is as effective as the gas tax method is for highway work but based on a source to be benefited by the funds to be raised. The sooner politicians become politic, the sooner will they realize the mistake of raiding the funds created by the one economically justifiable toll of the many imposts levied by governmental taxing bodies.

The gasoline tax for road building purposes is equitable because it is assessed against those who use the roads, the tax being a proportion to such use. For any other purpose the gasoline tax is inequitable because it places a second tax for such purposes on the vehicle owner, who already pays general taxes.

Owners of 26,000,000 motor vehicles paid almost $1,000,000,000 in special motor taxes in 1931, according to the National Automobile Chamber of Commerce. In addition, they paid large sums in personal property and other general taxes.

According to the same reliable source an automobile owner pays taxes amounting to 18 per cent annually on the average value of the vehicle during its lifetime, as compared with annual real estate taxes on urban land of 2.4 per cent and farm land of 1.6 per cent. The expense of road building and maintenance is borne by motor taxes and not by general taxes.

Examples of Tax Diversion.—As indicating the extent to which gasoline tax diversion may be foisted upon the motorists, the New York state chapter of the Associated General Contractors of America, in a recent communication to Governor Roosevelt and the state legislature, said:

"In contrast with this drastic and far-reaching reduction in funds for needed public works, the gas tax has been increased 1 ct., which is estimated to produced $15,000,000, and it is proposed to raise an additional $11,000,000 from an increase in fees on motor buses and trucks, a total of 26,000,000, none of which is to be devoted to highways or the public works program."

Diversion of the gasoline tax for purposes other than roads is contrary to good public policy; it encourages the diversion habit with lawmakers.

The *San Francisco Chronicle* pointed out this danger clearly when it said in an editorial carried in its issue of August 27, 1931: "The slightest diversion of it (gasoline tax money) to any other state purpose will be the signal for a general scramble for the gas tax trough. The moment the gasoline tax is saddled with any other revenue need—no matter how commendable the object—the way will be opened to draw any or all other state taxes from the motorist's gas tank. . . . the precedent will have been set, the sound policy of the past will have been broken, and any or every tax use may demand a seat on the gas wagon."

The *Los Angeles Herald and Examiner* said recently: "Permit this grab, and the door will be opened wide for other diversions in the future, not only by the state, but also by county and municipal governments which may find themselves faced with the necessity of retrenchment or the discovery of new sources of income."

RECENT IMPORTANT DIVERSIONS OF THE GASOLINE TAX

Florida: Net receipts from 6-ct. tax, $13,655,175. Of this, $3,803,629 was diverted for schools and school buildings, and $19,680 for reserve fund.

Georgia: Net receipts from 6-ct. tax, $13,435,062. Of this, $2,238,477 was diverted for public schools.

Louisiana: Net receipts from 4-ct. tax, $7,546,448. Of this, $155,178 was diverted to purposes of the state dock board.

Maryland: Net receipts from 4-ct. tax, $6,991,188. Of this, $1,381,438 was expended on city streets and grade crossings, and $75,000 was diverted to the State Conservation Department for oyster propagation.

Mississippi: Net receipts from 5-ct. tax, $6,917,575.

Of this, $207,440 (largely from an extra 2-ct. tax in Harrison county and an extra 3-ct. tax in Hancock county, both for sea wall construction) was expended for sea wall financing.

New Jersey: Net receipts from 2-ct. tax, $11,380,231. Of this, $90,000 was spent for the free Bridge Commission and the Department of Navigation and Commerce, and $3,000 for the Public Utilities Commission.

New York: Net receipts from 2-ct. tax, $28,476,290. Of this, $1,421,314 was paid to New York City and $50,000 was held in reserve for refunds.

Texas: Net total receipts from 4-ct. tax, $29,527,098. Of this, $7,381,774 was diverted to the free school fund.

There have been additional smaller diversions for miscellaneous purposes. Diversions of gasoline tax funds from highway construction for street improvement, amounting to $11,842,930, were not listed above, as this use, while technically a diversion, probably falls within the purpose of the tax as understood by most motorists.

Summary of Gas Tax Diversions.—During 1930, the states and the District of Columbia collected a net total (after refunds) from gasoline taxes of $494,683,410. This fund was expended as follows:

For construction and maintenance of state highways	$338,977,791
For construction and maintenance of local highways	96,225,637
For state and county road bond payments	31,049,036
For miscellaneous purposes (all diversions)*	27,328,759
Collection cost (when taken from gas tax revenue)	1,102,187
	$494,683,410

*This item divided as follows:

For city street work	$11,842,930
For city bridges	90,000
For public schools	13,404,200
For all other diversions	1,991,629
	$27,328,759

Such diversions break faith with the motorist. The popularity of the gasoline tax is entirely dependent upon the use of the proceeds to provide good roads.

SOME CONTEMPORARY OPINIONS

"This," says a Louisiana contemporary (referring to diversion of the gasoline tax for purposes other than highways) "is a perfect example of the lengths to which officials have sought to go in socking the motorist's pocketbook."—*Alexandria* (La.) *Town Talk.*

"The diversion of motor-vehicle taxes to other than road purposes is not only unjust to the motorist taxpayers, but when added to evasion and racketeering is demoralizing and threatens the breakdown of this entire tax structure," said Thomas P. Henry, American Automobile Association at hearing of Ways and means Committee, House of Representatives, January 23, 1932.

The legality of using state gasoline tax money for purposes other than the construction of roads is questionable, inviting court attacks with probable interruption to collection and tying up of funds already collected.

The *Quincy* (Ill.) *Herald-Whig* for January 14, 1932, says with respect to the Barbour bill passed by the Illinois senate to divert a portion of the state gasoline tax allotted to the counties for the building of highways:

"It was only after there was assurance from the governor and those in control of the general assembly that this money could be used for road purposes only, that the (gasoline tax) law was passed. So far as the counties' share is concerned, the law makes it plain that this money can be used only in retiring bonds issued for the construction of state aid roads, or for the construction of such roads. The law passed by the senate would nullify the provisions of the gasoline tax statute, in the opinion of Quincy lawyers."

The Illinois Petroleum Marketers, in a display advertisment carried in Chicago daily newspapers on January 27, 1932, said:

"The proposal that the (present) crisis be met by adding a cent or two to the tax on gasoline is unfair to those familiar with the gasoline tax situation. Necessity may compel some oil companies to refuse to collect a higher tax if it is voted and to resort to the courts for justification of their stand against unfair discrimination. If some follow this course, all will have to do so in defense of their business."

Diversion of gasoline tax funds takes needed highway revenue. Attempts to restore this by increasing the tax are impractical because the point of diminishing returns has been reached.

Col. Sidney D. Waldon of the American Automobile Association testified as follows before the Committee on Ways and Means of the House on January 25, 1932:

"The motor levy today is the heaviest on any non-luxury form of property in the United States. It is twelve times as heavy as the tax on rural real estate. It is almost eight times as heavy as the tax on urban real estate. At the rate of the 1931 tax the average car during its average life period of seven years pays taxes in the amount of 139 per cent of its average value.

"As an indication of how an increase in taxation affects the use of motor vehicles in Alabama, permit me to quote form a letter received from Leroy F. Hill, secretary of the Alabama Motorist Association, Birmingham, where there is a one cent city gas tax in addition to the state tax of 5 cents, as follows: 'You no doubt received my telegram estimating 60,000 registrations less in Alabama than on this date last year, and 75,000 less than for the preceding year.'

"At the present moment no less than 12 different forms of taxes on passenger cars have secured a foothold—State registration fees, state gasoline taxes, state personal property taxes, state driver's license fees, state registration card fees, state certificate of title fees, county gasoline taxes, county personal property taxes, city gasoline taxes, city personal property taxes, city wheel taxes, city driver's license fees, and city registration fees. It is understood that the 12 taxes cited are not levied in any one place.

"The experience of Pennsylvania is particularly noteworthy. On July 21, 1929, the 3-ct. tax was increased to 4cts. Nine months later, or in May, 1930, Pennsylvania collected $2,681,448 under the 4-ct. tax. On July 1, 1930, the tax was decreased from 4 cts. to 3 cts., and 10 months later, or in May, 1931, collections under the 3-ct. tax soared to $3,880,815. Thus with a tax of 1ct. less, collections were $1,200,000 or 46 per cent greater. In May, 1930, gasoline taxes in Pennsylvania were reported on 67,000,000 gal. while in May, 1931, under the lower rate, taxes were reported on 126,556,849 gal. Quite clearly lower taxes increase motor-vehicle use."

Modern highway requirements demand a fixed income for roads. Diversions from road money throw any system into confusion, causing waste and delay.

Must Stabilize Road Programs.—Stabilization of highway programs and income are absolutely essential to the orderly progress of highway transportation. The American Road Builders' Association has made this point clear through frequent utterances and has backed it up with its continued efforts for non-diversion of gasoline tax funds.

It is certainly good business to continue road improvement at a steady pace during 1932, while the road dollar will buy more construction value than ever before and probably more than it will buy for many years to come.

Road building has not only aided the industries directly engaged in construction, materials and machinery, but it has increased the value of motor vehicles, sustaining the automobile and truck industry.

Frederick E. Everett recently said in commenting on the necessity of continuing road building on its present scale:

"We need good roads because we have some 26,000,000 passenger cars, trucks and buses, vehicles which during the lean year of 1931 were given a greater usage than ever before. Every dollar taken away from road building reduced the utility of the automobile and therefore its value. Every dollar spent in road betterment makes the car worth more. Neither the highway nor the automobile can be evaluated alone; both must be weighed together and considered as a single transportation medium.

"The automobile industry is the largest industry, employing in one way or another one-tenth of the nation's workmen. It is large because it serves a public demand and because the United States is building roads."

The gasoline tax relieves real estate of its tax load. Divert the gasoline tax and road expense must revert back to general taxes.

Motor vehicle taxes amounted to $1,002,000,000 in 1931, divided as follows: Gasoline tax, $524,000,000; license fees, $348,000,000; personal property and municipal taxes, $150,000,000, according to testimony submitted by the National Automobile Chamber of Commerce before the hearings of the Committee on Ways and Means of the House on January 23, 1932.

Motor vehicles paid nearly 10 per cent of all federal, state and local taxes, according to the National Industrial Conference Board. Motor taxes amounted to $1,022,000,000 as contrasted with total federal, state and local taxes, amounting to $10,251,000,000.

Were real estate taxes called upon to replace gasoline tax funds *the consequent increase in the former would have amounted to over 5 per cent.*

Diversion of gasoline tax money causes unemployment. Since an exceptional proportion of road construction costs goes into labor, the diversion of the money to other purposes invariably cuts down employment.

The following tabulation showing what a large proportion of highway expenditures goes to labor was contained in a statement by Thomas H. MacDonald, chief of the United States Bureau of Public Roads, before the subcommittee of the Committee on Appropriations, U. S. Senate, in January, 1932:

DISTRIBUTION OF $1,000 PAID FOR CONCRETE HIGHWAY, SHOWING THE APPROXIMATE TOTAL AMOUNT WHICH REACHES LABOR IN EACH OF THE EIGHT SUCCESSIVE STEPS

The contractor's distribution of this $1,000:	
Labor	$ 141.00
Aggregates	324.00
Cement	324.00
Steel	27.00
Equipment	100.00
Plant installation	27.00
Bonding, etc.	22.00
Gross profit	35.00
	$1,000.00
After distribution of mill and quarry items:	
Salaries and wages	$ 302.70
Freight	406.70
Materials and supplies	17.50
Fuel	35.50
Interest	14.10
Taxes	24.10
Depreciation and repairs	131.15
Depletion	10.50
Profits	48.10
Miscellaneous	10.00
	$1,000.00
After distribution of freight charges:	
Salaries and wages	$ 477.70
Materials and supplies	57.55
Fuel	57 20
Interest	61.70
Taxes	49.70
Depreciation and repairs	184.65
Profit	91.00
Depletion	10.50
Redistribution	10.00
	$1,000.00
After distribution of fuel costs:	
Salaries and wages	$ 516.60
Materials and supplies	64.20
Interest and rents	63.75
Taxes	51.40
Repairs and depreciation	188.75
Profit	191.00
Depletion	14.90
Redistribution	10.00
	$1,000.00
After distribution of repairs and depreciation:	
Salaries and wages	$ 572.60
Materials and supplies	170.80
Interest, rents, etc	65.65
Taxes	56.10
Depletion	14.90
Profit	109.85
Redistribution	10.00
	$1,000.00
After distribution of cost of materials and supplies:	
Salaries and wages	$ 730.25
Interest and rents	73.85
Taxes	39.50
Depletion	17.85
Profit	128.55
Redistribution	10.00
	$1,000.00
After distribution of taxes and $10 for "redistribution" has been redistributed:	
Salaries and wages	$ 770.85
Interest and rents	81.25
Profits	129.85
Reserve for depletion	18.05
	$1,000.00
After distribution of profits, interest, rents, and depletion:	
Salaries and wages	$ 910.00
Expended by owners	90.00
	$1,000.00

This statement indicates that out of $1,000 invested in concrete highway the contractor pays job labor $141.00; quarry and mill costs contribute a salary and labor item of $161.70 which added to the road labor becomes $302.70. Similarly, the freight item adds $175.00 to labor, the fuel labor items $38.90, repairs and depreciation includes $56.00 for labor, the material and supply account includes labor items totaling $157.65. Tax and sundry accounts add $40.60 for salaries and wages. The salary and wage items included under interest, rents, profits, reserves, etc., total $139.15 making a grand total of $910 or 91 per cent of the original $1,000 spent for wages and salaries.

Before hearing of Senate Committee on Post Offices and Post Roads, January, 1932, Senator Carl Hayden (Arizona) said:

"I inquired of Mr. MacDonald (chief of the U. S. Bureau of Public Roads) and the other officials as to how many men were employed, and their answers show that the difference between the number who worked on the roads last year and those who will be employed this year is between fifty and sixty thousand. In other words, between fifty and sixty thousand men who had work by reason of Federal road appropriations will be thrown into the body of the unemployed, and no work will be provided for them. It appeared to me that the only way to meet that situation was to offer an amendment to his bill providing for a second emergency road appropriation, and that is the purpose of my amendment."

"New York state employed in 1931 some 45,000 men directly and indirectly on highway construction and maintenance. The total expenditure of $60,000,000 averaged $1,333 per man, of which the man actually gets about 90 per cent or $1,200. One hundred dollars a month is little enough for a man to support a family on. There may not be the necessity to continue highway improvement continuously on the 1931 scale, but abrupt and unjustified curtailment will cause greatly increased unemployment, further depression in many lines of business and actual suffering."

The above is quoted from a brief submitted in opposition to New York state tax diversion.

Diversion of gasoline tax receipts is decidedly unpopular and may destroy the benefits of the tax to road building as well as to the uses for which funds are diverted.

The Public Backs Us.—Typical comment on this phase of the diversion danger, clearly indicates the trend of popular opinion:

"When other uses break into this revenue source the gas tax will no longer be paid cheerfully. Motorists will revolt and the

upshot will most likely be the smashing of the state's highway program."

"When diversion has been made, strenuous objections arise from motorists and likely they eventually will force lower gasoline tax rates that would be disastrous for road building."

"The Automobile Merchants' Association of New York is not opposed to a gasoline tax in principle, but we are very definitely opposed to spending the money collected from this revenue for any other purpose than the construction, reconstruction and maintenance of highways."

"The people of this state are satisfied with the gasoline tax, but they want it used on the highways, and the diversion of it to other purposes will not be tolerated."

"The proposal to increase the state gasoline tax and devote the extra funds thus raised to unemployment relief is creditable to the hearts of its makers but not to their heads. Never under any circumstances should gasoline tax money be used for any other purpose than highway building and maintenance."

"It behooves every citizen to take notice of the danger which threatens our state road system by the advocacy of this diversion proposal. It should, moreover, be the aim of every taxpayer to oppose to the utmost every confiscation of highway taxes for any other purpose whatsoever."

Diversion of gasoline tax money, by delaying highway construction and maintenance, increases the operating cost of motor vehicles.

The following table, taken from "Operating Cost Statistics of Automobiles," a bulletin by Professors T. R. Agg and H. S. Carter of Iowa State College, gives enlightening information on this subject:

EFFECT OF ROAD CONDITION ON VARIOUS ITEMS OF OPERATING COST

Item of cost	Sum expended for the item when using high type roads	Sum required for equal mileage on intermediate type roads	Sum required for equal mileage on low type roads
Gasoline	$1.00	$1.20	$1.47
Oil	1.00	1.00	1.00
Tires and tubes	1.00	2.22	2.90
Maintenance	1.00	1.20	1.47
Depreciation	1.00	1.10	1.24
License	1.00	1.00	1.00
Garage	1.00	1.00	1.00
Interest	1.00	1.00	1.00
Insurance	1.00	1.00	1.00

Diversion of gasoline tax receipts to other purposes makes payments on outstanding highway bonds an obligation against general taxes with possibility of increasing the latter.

Gasoline tax revenue is pledged for the payment of interest and principal on outstanding highway bonds in the following states: Arkansas, Delaware, Iowa, Louisiana, Michigan, New Jersey, North Carolina, Oregon, South Carolina, and West Virginia.

If diversion of road funds is permitted, it is likely to be attempted in preference to seeking economies in governmental administration.

▲

Safety Engineering on Wayne County Highways

SAFETY engineering enters into every phase of the work of the county road commissioners of Wayne County, Michigan, both as it pertains to working conditions for the men within the organization and also as it affects the public on the highways. An interesting summary of this safety engineering work is given in the 25th annual report (1931) of the County Road Commissioners as follows:

Design and Maintenance.—The designer has safety in mind when he lays out a road, bridge or grade separation. The passages are made wide and kept clear of all obstacles. All the newer bridges are built at least as wide as the pavement, so as to leave no sidewalks or hand rails in the way of traffic.

Widened pavements permit a greater flow of traffic at higher speed and with more safety. The latest design of roadway calls for wide shoulders and the elimination of deep ditches. A deep ditch is always a menace in wet or icy weather.

The road patrol keeps a continuous watch for breaks in the pavement, holes in the shoulders and all obstacles in the way of traffic. The signal men change the bulbs in electric signals and lights every 1,000 hours to be sure they are constantly burning, and these men are on duty day and night whenever defective light bulbs burn out, or a faulty signal control requires attention. Arrangements are made with adjacent residents, gas stations, etc., to report a defective bulb or improperly working signal and all county road employees noticing such defects are required immediately to report the matter by telephone.

Shops and Construction.—In the repair shops and construction yards, where conditions can be controlled and kept nearer to the ideal, very few accidents occur.

However, on construction jobs, in maintenance gangs on the highway and in forestry work, the natural hazards and speed and density of traffic are so varied and uncontrollable that they require the constant vigilance of the men in charge of work in order to prevent accidents.

Whenever traffic passes close to a construction job, warning and direction signs are erected to protect both workmen and the driving public. At night these signs are lighted by lanterns, flares or electric flood lights.

Railroad Crossings.—The greatest step for the public safety is the building of grade separations at railroad crossings and at important highway intersections. Forty-eight such grade separations are already built or under construction, and annually save many lives and thousands of dollars worth of time and property.

At all railroad crossings where there are no grade separations, flashing danger signals are installed. This year, due to new road construction, there were four new railroad crossings all equipped with danger signals. Two old crossings had additional protection installed for sidetracks. All railroad warning signs, which are erected several hundred feet to each side of the railroad crossing, are being outlined by glass reflector buttons. This will be an additional warning to motorists driving at night.

Road Intersections.—Where electric service can be had, electric traffic signals are installed at all intersections of concrete roads. These are the best substitute for grade separation to provide for safety of the driving public. One need only compare the number of accidents at road intersections, where there are no signals, with those occurring where traffic signals are installed, to be convinced of the value of this equipment.

Most serious accidents at intersections are caused by drivers who run through red lights. This class of driver has a selfish indifference to the rights of others, or has a false sense of being greatly delayed. Fifteen seconds delay is a small price to pay for a life.

Often the driver going through an intersection on the green light is partially at fault in an accident, in that he races through at high speed instead of slowing down to a rate at which he can control his car. There is no speed limit in Michigan, but this fact does not preclude sensible rates of speed for all occasions.

CONTROL *and* DESIGN *of* MULTIPLE INTERSECTIONS

THE great variance in the volume turning movements and general characteristics of traffic at different intersections makes it impossible to formulate rules for intersection design or control which may be applied thoughtlessly to all intersections of a given type. This is particularly true of multiple intersections where more than two streets cross at a point,

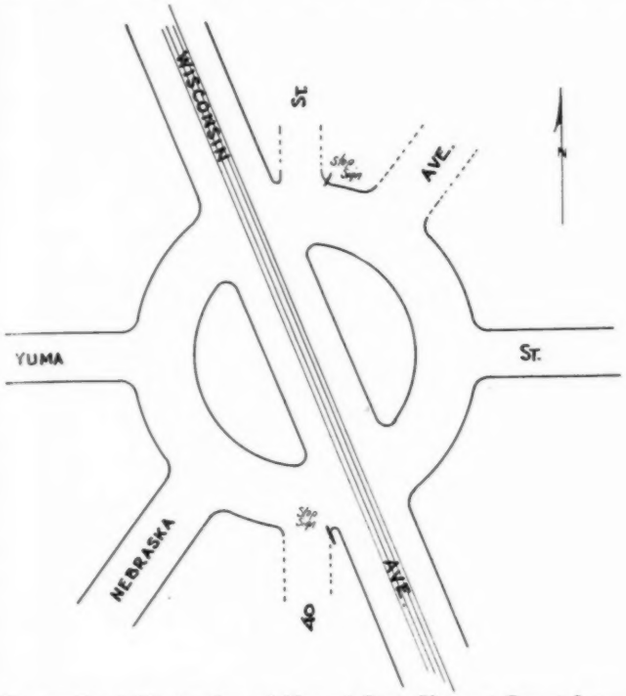

Fig. 1—Good Illustration of Use of Stop Signs at Street Intersection, Washington, D. C.

thereby increasing the number of conflict points and the traffic load. Each intersection is a special case and warrents careful study, both of physical layout and traffic characteristics. In the matter of relative delay to vehicles and accident hazard under various types of control and design there is yet much to be learned. This paper, therefore, does not attempt to lay down hard and fast rules, but rather to present, largely pictorially, control methods and designs which have proven successful in operation to indicate general rules which have evolved through experience, and to invite discussion upon a subject in which there is room for considerable improvement.

Much of the material on rotary traffic is taken from a report prepared for the Albert Russell Erskine Bureau for Street Traffic Research of Harvard University and grateful acknowledgment is made to the authors, Messrs. L. S. Tuttle and E. H. Holmes, former Erskine Fellows.

Stop Signs.—The use of stop signs as a method of control at multiple intersections is of doubtful value except where the greatest volume of traffic is carried on one street and the volume of cross traffic is negligible, or when the vision of approaching driveways is obstructed by walls, hedges or other objects. The chief advantage of stop signs is the ease and cheapness of installation and the low maintenance cost. Against this advantage, however, must be equated the cost of enforcement and the element of danger introduced when observance is poor. Figure 1 is a good illustration of the use of stop signs. The intersection is that of Nebraska Ave. and Wisconsin Ave. in Washington, D. C. Wisconsin Ave. carries the bulk of the traffic, and cross traffic on Nebraska Ave. and Yuma St. is forced to stop before entering the intersection.

Officer Control.—When traffic volume or turning movement increases to the point where confusion and congestion result with stop sign control, officer control may be resorted to. This type of control seems to be particularly advantageous where there is a short peak flow of traffic and when officer control is not necessary at other times. In such cases, the expense of installing signal lights may not be justified, to say nothing of the unnecessary delay to traffic during periods of light traffic. The great disadvantage to the use of officer control is that in many multiple intersections there are large open spaces and several points of conflict, making it difficult for drivers to interpret an officer's signals. Again, where these conditions make it advisable to provide more than one officer, considerable unnecessary delay is practically unavoidable because of the inability of officers to coordinate their signals. The variation in the effectiveness with which individual officers control traffic is also a factor. Clarence Taylor, Traffic Engineer for the Massachusetts Department of Public Works, made an interesting delay study where one officer succeeded another in the control of an intersection during a period of heavy traffic. The second officer

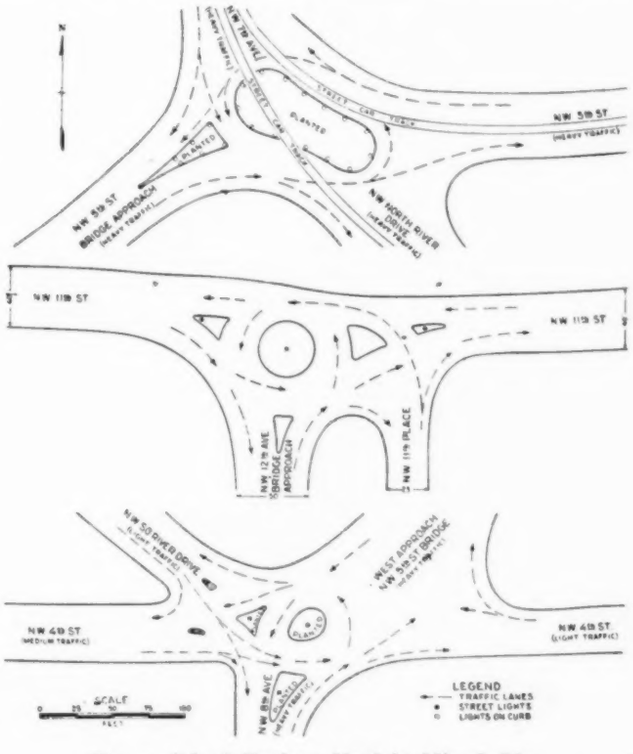

Fig. 2—Island Designs Used in Miami, Fla.

in this case by a better timing of his signals to traffic, caused but one-third the delay of the first.

Signal Light Control.—Signal light control is probably the most effective method of control where traffic volume is sufficiently heavy to warrant it and where protection to pedestrian traffic is important. However, the cost of installation and operation of signals is high and much care should be exercised to avoid the use of lights where they are not warranted.

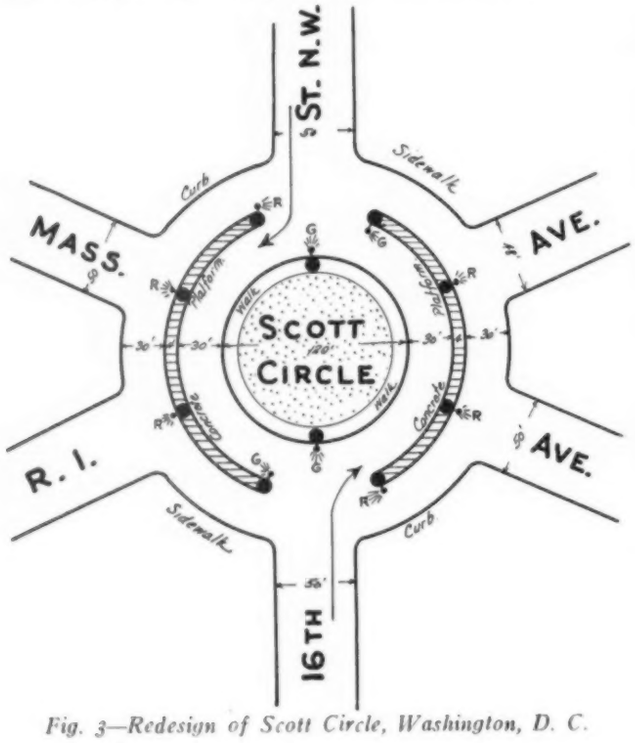

Fig. 3—Redesign of Scott Circle, Washington, D. C.

In planning a signal control, considerable thought should be given to the proper placement of signals to secure maximum visibility and provide a definite indication to each stream of traffic which it is necessary to control.

The use of individual signal standards in conformity with the Standard Signal Code, showing a separate series of red, green and amber lights to each controlled traffic movement is advisable.

The requirement of multiphase operation of signal lights at multiple intersections is a distinct disadvantage which seriously increases the cost, and also the delay to traffic. It would seem from observation of numerous signalized intersections that this fact had been lost sight of when consideration was given to the most efficient type of control.

Vehicle-Actuated Control.—Great difficulty is experienced at signalized intersections in setting cycle and interval lengths to secure maximum efficiency in passing traffic. They are usually set to accomodate traffic during the maximum periods of perhaps two hours per day, with the result that during the remainder of the time traffic is aggravated by unnecessarily long stop periods. Vehicle-actuated signals are much more flexible in this respect, the traffic at any one time setting the lights to the proper intervals, and are no doubt justified where there is a heavy volume and a wide fluctuation of traffic during the day. Traffic actuated control, however, is more expensive than fixed time control, costing from 1½ to 2 times as much as fixed-time control.

One-Way Regulations.—Often a very effective method of control at multiple intersections is to make certain minor streets one-way out of the intersection, and force traffic approaching on these streets to turn into the major streets one block away from the intersection. This regulation may be used effectively alone or in conjunction with other methods of control. The advantage gained is a considerable reduction in the number of conflicts within the intersection area.

Methods of Design.—In the foregoing discussion consideration was given only to methods of controlling the intersection area as laid out with no thought of changing the physical design. In many cases, necessity for control may be eliminated or the operation of control devices considerably improved by minor changes in the layout of the intersection such as the installation of directional islands or paint lines on the pavement.

No specific rules may be laid down, but in general it may be said that any changes which makes the proper courses of the various traffic streams the natural routes for vehicles to follow will be effective. Misplaced directional islands, beacons, and paint lines tend to hinder free movement and cause confusion, delaying rather than expediting traffic.

Directional islands are particularly useful in intersections where large open areas would otherwise confuse drivers. In designing and placing these islands properly the following rules are helpful:

1. Allow all streams flowing in the same general direction to converge at a flat angle and flow together.

2. Endeavor to eliminate acute angled crossings and head-on conflicts.

3. Where control is necessary, bring opposing streams to a point, and make the crossing as nearly as possible at right angles.

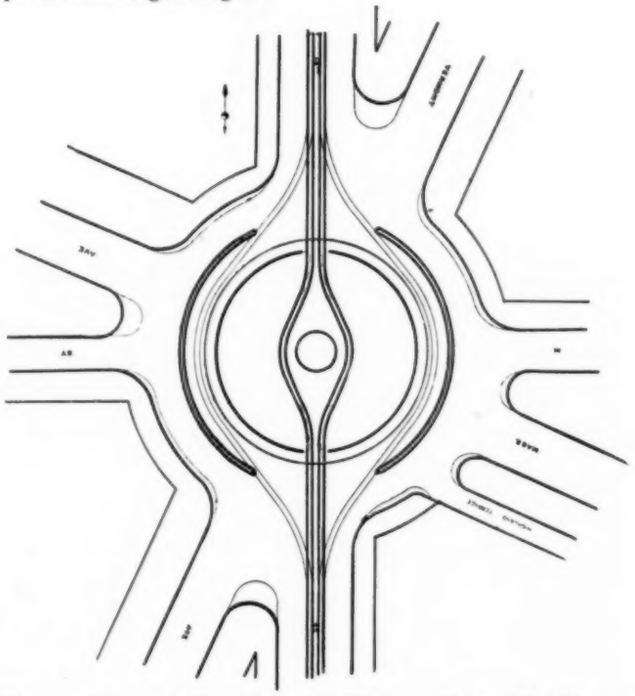

Fig. 4—Proposed Treatment at Thomas Circle, Washington, D. C.

4. Place islands in such a position that immediately a vehicle enters the intersection the proper course becomes obvious. Make the proper course easy to follow and with obvious continuity through the intersection.

5. Avoid the installation of islands or beacons so placed that their function must be indicated by infor-

mational signs. Warnings such as "Slow—Keep Right" are often helpful, but beacons or islands should not be so placed that information such as "Turn Left of the Signal," is necessary. Pausing to read such information causes hesitation, and unnecessary delay; failure to read and observe it may result in accident.

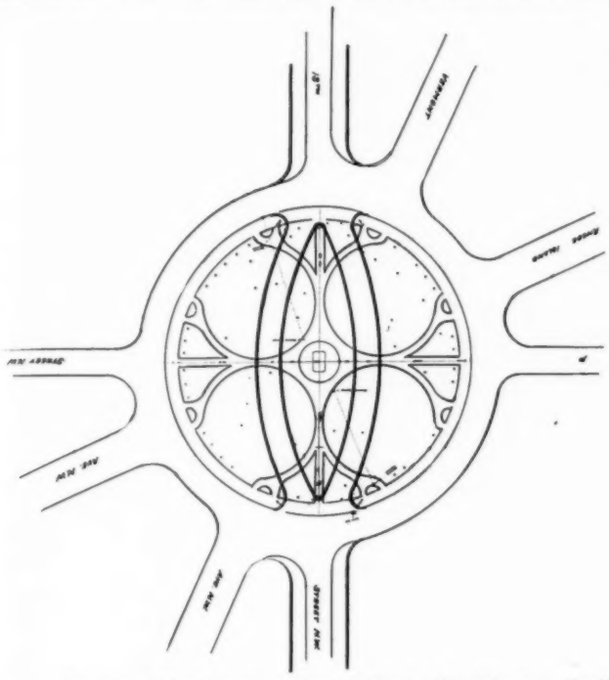

Fig. 5—Proposed Treatment at Logan Circle, Washington, D. C.

Nearly every city has examples of beacon or island installation. Some excellent designs from Miami, Fla., are reproduced here, Fig. 2. The islands indicated, which are now curbed and landscaped, were not installed in permanent form until their operation had been tested by temporary stanchions. These stanchions were moved until the most efficient design for the islands was obtained, in some cases the period of trial and experiment lasting more than a month. Very satisfactory operation of these intersections is reported. Other designs included show a number of varied conditions and the existing solutions. Proposed island designs may also be tested by the use of white sand bags laid end to end and outlining the islands. The position of the sand bags can be readily changed until the most effective island design is secured.

Rotary Traffic.—Rotary traffic, the one-way movement of vehicles about a central island usually circular in shape, is found in a great many cities. These traffic circles as they are commonly referred to, were not designed for present traffic conditions in most cases. Their use as media for motor traffic control is comparatively recent.

The city of Washington has more circles than any other American city and for this reason it is interesting to trace their development. The original city plan of Washington, as designed by Major L'Enfant, the French engineer and city planner, had for its salient features the Capitol and the Washington Monument which determined the axis for the Mall, and the Executive Mansion, which with the Capitol and the Monument formed a right angled triangle. The street system was laid out with the Capitol as a center, the lettered streets paralleling the Mall, and the numbered streets at right angles to them. For ease of travel between the salient points mentioned as well as between other probable centers, L'Enfant superimposed upon this rectangular system a diagonal system of avenues radiating from the Capitol, supplemented by other diagonals paralleling or intersecting them.

This angular intersection of the street system provided unusual opportunities for beautification by virtue of the numerous odd shaped parcels of land created. The climaxing features were the larger areas at the intersection of several streets and avenues, the treatment of which resulted in the establishment of large circular plots. These multiple intersections, with their beautiful treatments, and the pleasant vistas offered by the streets radiating from them, add to the beauty of the city, but unfortunately offer serious obstacles to the free movement of traffic because they were not designed for modern traffic.

It was not until well after the advent of the automobile that any thought was given to the movement of traffic about the circular areas. As traffic increased, however, it became necessary to require one-way movement about the circles. Since that time the volume of traffic has steadily increased, requiring new measures varying with the situation as evidenced by the installation of pedestrian lights, and even the complete redesign of Scott Circle, Fig. 3. Plans are proposed for a similar treatment of Thomas and Logan Circles, Figs. 4 and 5. In Washington, therefore, rotary traffic is not a solution of a traffic control problem; it is an expedient made necessary by the existing design. This same situation exists in Indianapolis, the plan for which was devised by an assistant to Major L'Enfant and also provides a diagonal system superimposed upon a rectangular system. Here the salient point is Monument Place, a circular park from which radiate four streets and where rotary traffic is now in operation. Niagara Square in Buffalo, and the one-way street system around the Capitol at Madison are among the many examples of similar situations.

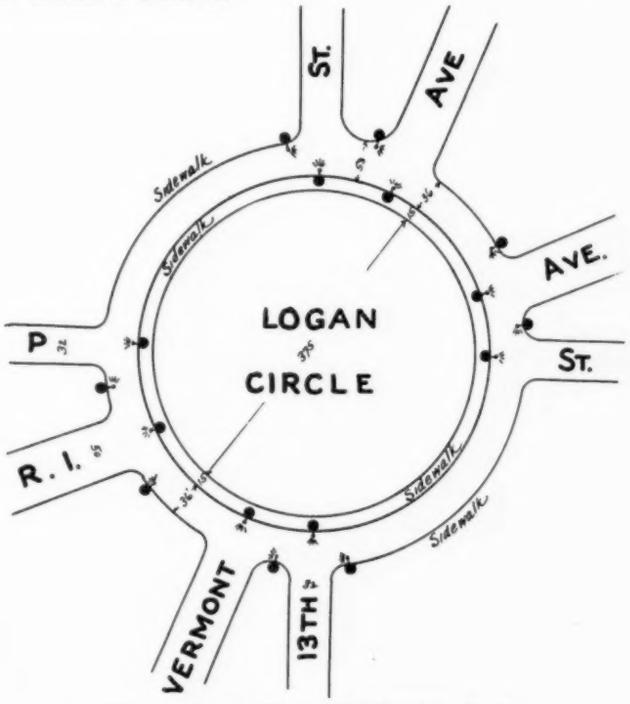

Fig. 6—Logan Circle, Washington, D. C.

The better known circles of Washington, Logan, Thomas, Scott and DuPont, Figs. 6, 7, 8, are obviously congested, offer a very definite obstacle to the free movement of traffic, are confusing to drivers, espe-

cially to the numerous visitors to Washington, and are sources of distress to pedestrians and inconvenience to street cars. This situation often leads to criticism of traffic circles in general, it quite commonly being forgotten that in the design of the Washington circles the movement of automobiles was not even considered. The failure to function well should be attributed not

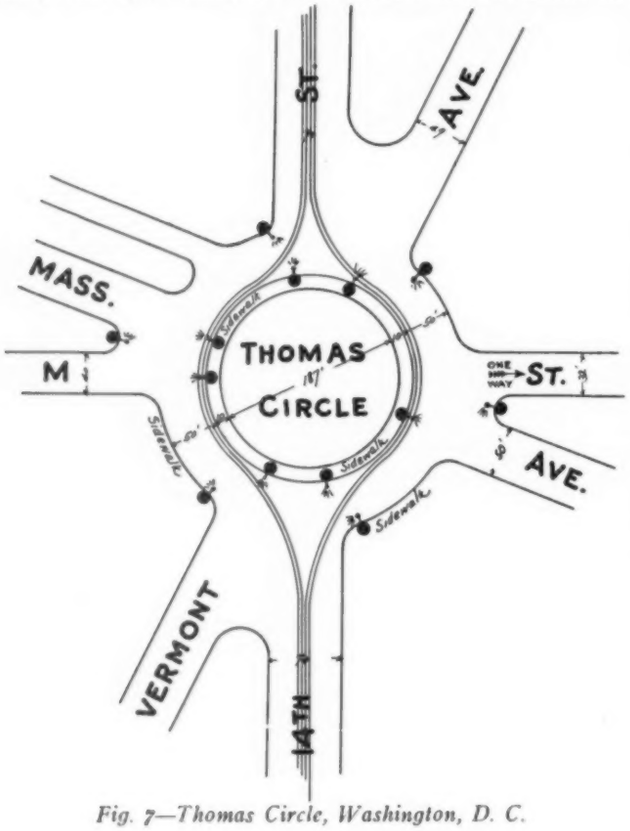

Fig. 7—Thomas Circle, Washington, D. C.

to the fact that they are traffic circles, but rather to the fact that many of the most fundamental requirements for successful operation of a traffic circle are lacking.

Inspection of the circles in Washington reveals that one of the greatest difficulties lies in the handling of the pedestrians. Rotary traffic infers continuously moving traffic, which is essential to the process of interweaving. If signalizing to permit pedestrian movement is necessary the continuity of flow is interrupted, resulting in an accumulation of vehicles at the points of stoppage. When the vehicle interval starts again, the common surge of vehicles stopped within or just outside the circle hinders the interweaving.

Another noticeable feature is that in the operation of a single circle the efficiency varies considerably at different points. It is quite apparent that where the entering streets are near together the interweaving process is prevented, and in its place appears the right angled conflict between the traffic entering the circle at one street and that leaving at the next. Where a considerable distance between streets is available interweaving is easy and traffic flows freely. Street cars offer another obstacle to freedom of movement in certain cases. Being confined to a fixed path, the movement of street cars is hindered by encroachment on their only path by the more mobile units, which results in the slowing down of the cars and the blocking of the roadway. Still further difficulty is encountered in the narrow roadways found on certain circles. In many cases pinching of vehicles between other vehicles or between vehicles and the curb results in marked decleration or in stoppage. This is unavoidable when two lanes of vehicles enter a three-lane roadway already carrying two lanes of moving vehicles. A factor which aggravates the condition just mentioned is the short radii of the curbs at the intersections of most of the entering streets with the circular roadways. These curb radii are so short in many instances that it is impossible for a vehicle to negotiate the turn without swinging well out into the rotary roadway.

The fact that traffic flows through these intersections as well as it does, in the face of the unavoidable difficulties is distinctly favorable to the rotary system of traffic control.

The State Highway Department of New Jersey has given much thought to intersection design. Within the last few years many intersections have been improved by a separation of grades, or especially at multiple intersections, by the installations of rotary traffic islands. These installations, contrary to the case of the usual city circle, have been designed for the sole purpose of handling traffic. The many bad features found in the Washington circles have been avoided. Since most of the intersections are rural in character, street car and pedestrian movements were seldom a consideration. The central islands have radii such that a reasonable speed may be maintained around them. The islands are not necessarily circular, as may be noted in the illustration, Fig. 11, but are so designed that between any two streets sufficient distance for interweaving is available. The curb radii of the entering streets are long, and encourage the driver to follow the curb closely, and not encroach upon the adjacent traffic lanes. Large areas of pavement which would be confusing and

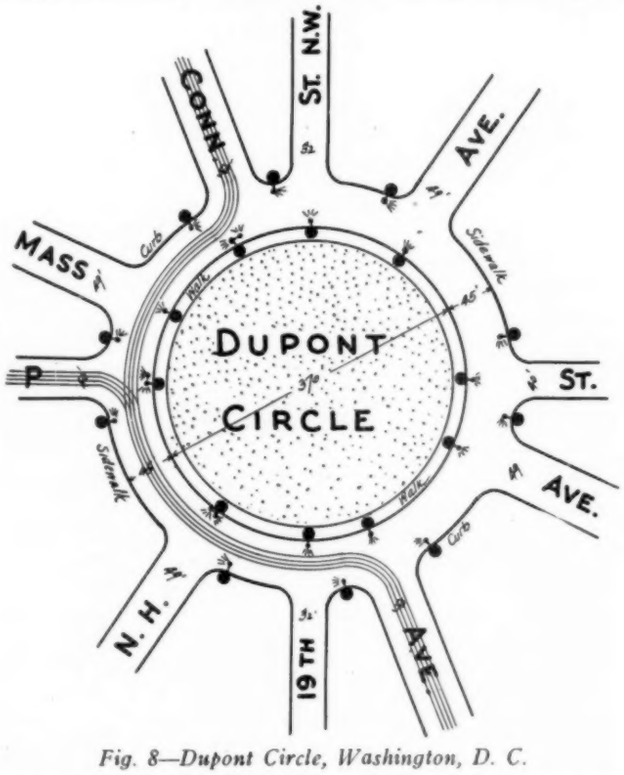

Fig. 8—Dupont Circle, Washington, D. C.

which under proper driving would not be travelled over are eliminated in favor of directional islands, as seen in the throats of the entering streets. Finally the routes through the circle are carefully marked, and the signs, as well as the circles themselves are adequately lighted at night.

The difference between the efficiency of operation of these circles and the Washington circles is evidence of the necessity of careful attention to details of design if rotary traffic is to function effectively. The circle must be designed for the traffic; vehicles will not follow an unnatural course necessitated by a poor design.

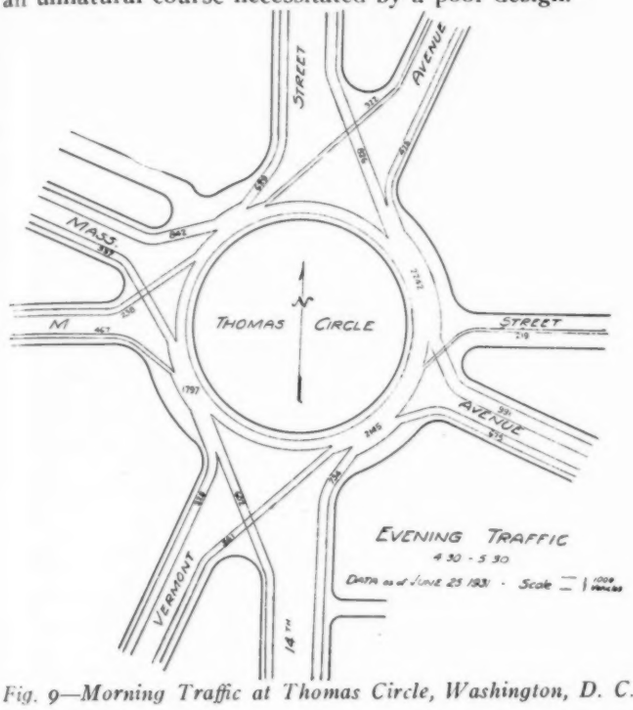

Fig. 9—Morning Traffic at Thomas Circle, Washington, D. C.

Important Feature in Design of Traffic Circles.—Features most important to the design of a traffic circle are:

1. The central island must have a radius sufficient for a vehicle travelling at the most desirable rate of speed to follow the inner curb closely. The radius must also be such that the distance between any two entering streets is sufficient for easy interweaving. Seventy-five feet is recommended as an absolute minimum radius, with 100 ft. being preferable. A speed of 20 miles per hour may be maintained around a 100 ft. circle without danger or discomfort.

2. The radius of the central island must be such that sufficient space for interweaving is available between any two entering streets. A distance of at least 150 ft. should be provided between center lines. A central island of 75 ft. radius with a rotary roadway of 40 ft. in width affords at a right angled intersection an interweaving distance of only 135 ft. This again indicates the desirability of a minimum radius of 100 ft. for the central island, which would provide in this case an interweaving distance of 170 ft. Where it is known that the interweaving of vehicles between any two streets will be exceptionally heavy, a distance of at least 200 ft. should be allowed.

3. The curb radius of the entering streets should be equal to the radius of the central island. Using a large radius such as this will encourage the driver to keep in his proper lane when entering or leaving the circle. Making the radii the same as that of the central island will permit a uniform speed through the intersection area.

4. The outer curb of the rotary roadway should be a tangent between the curbs of the adjacent entering streets. It has been evidenced repeatedly that when the outer curb is concentric with the inner curb vehicles entering at one street and leaving at the next will not follow the reverse curve, but will proceed on a straight line between the points of entrance and exit.

5. The width of the rotary roadway is most important. Too wide a roadway is confusing; too narrow a roadway hinders movement. A roadway which will provide one-quarter as many lanes as the total free lanes of traffic on the entering streets will be satisfactory. This rule is based on the assumption that all streets are flowing to capacity at the same time. Inasmuch as this condition seldom arises in practice satisfactory results can usually be secured with less than the above width. Further, it is doubtful if good operation results where the width is greater than four lanes. Confusion is apparent on such wide roadways, and since interweaving is primarily a factor of distance rather than width, greater distance between streets will be more effective than exceptional width. The use of lanes of traffic rather than feet of width eliminates the factors of odd widths of entering streets and of parking restrictions when computing a circular roadway width. Furthermore, the width of a lane of traffic should be normally greater on a circle than on a tangent. It is recommended that the width of the rotary roadway be 12 ft. per lane rather than the usual 10 ft.

6. Auxiliary triangular islands in the throats of the entering streets, as indicated in the accompanying diagrams, materially assist in directing traffic entering the circle, and prevent left turns. Incidentally, they provide excellent pedestrian safety zones and locations for the erection of directional signs. The shape and position of these islands is invariably outlined by the traffic pattern upon the circle.

7. Features not included in design but quite as essential to the operation of circles are the signing and lighting installations. Warning beacons should be placed on all directional islands, in certain cases on the central island, and if necessary, at some distance back of the intersection on the incoming streets. Directional signs must be clear and easily readable, and routes should be marked continuously through the circle. All signs should be either reflecting or illuminated at night. In addition adequate lighting by street lighting fixtures

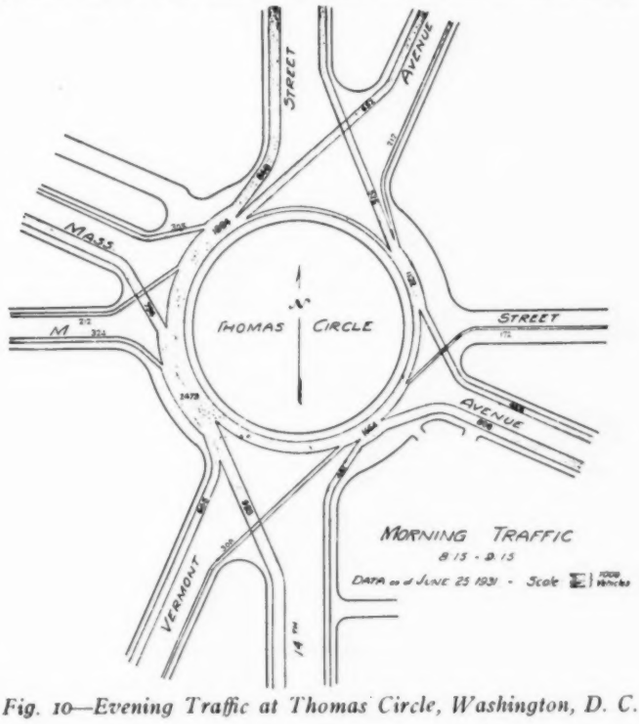

Fig. 10—Evening Traffic at Thomas Circle, Washington, D. C.

or by flood-lighting is necessary for successful night operation. To negotiate a circle on a rural highway requires considerable slowing down, and drivers, especially strangers must be amply warned as they approach the circle.

Advantages and Disadvantages of Rotary Traffic.—Rotary traffic has many advantages, but there are severe limitations to its application. The more obvious advantages are:

1. Rotary traffic tends to converge intersecting streams of traffic, and to substitute interweaving for angular conflict. When this is not the case the system cannot be considered true rotary traffic. It is especially beneficial at multiple intersections, where otherwise multiphase operation of control devices would be necessary.

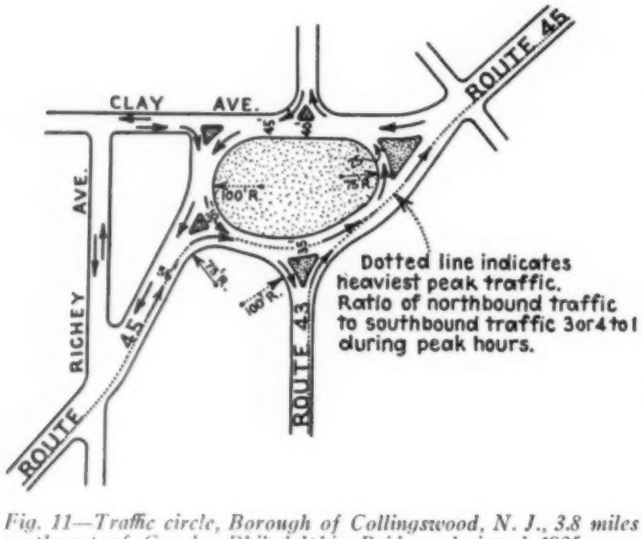

Fig. 11—Traffic circle, Borough of Collingswood, N. J., 3.8 miles southwest of Camden-Philadelphia Bridge; designed 1925, constructed 1926

2. In a well designed traffic circle there is no stoppage delay, and but little delay due to reduced operating speeds.

3. A well designed traffic circle can accommodate very large volumes of traffic effectively.

4. Left turns can be handled quite as effectively as straight through or right turn movement.

5. When land is available it is the least costly of the major treatments.

Against these advantages, however, there are various disadvantages to consider.

1. The large area of land required makes the installation of traffic circles impractical in congested areas.

2. The question of accidents is debatable. The general opinion, for which there is at present no factual backing, is that in traffic circles minor accidents such as fender scraping or slight rear end bumps are frequent, but that serious accidents are almost negligible.

3. The cost of operation, because of necessary lighting, is high, being comparable to the cost of operation of traffic signals.

4. Traffic circles are often confusing to drivers. This is a disadvantage in their operation, but should not be a deterrent to their installation. As more circles are installed, the efficiency of operation should be improved, the average driver becoming more accustomed to this type of control.

5. The greatest disadvantage is encountered in heterogeneous traffic. Where street car and pedestrian traffic, as well as in some cases horse drawn vehicles, must be accommodated successful operation is exceedingly difficult.

Acknowledgment.—The foregoing is a report presented Jan. 13 at the convention of the American Road Builders Association. The committee personnel were as follows:

Chairman, M. O. Eldridge, Assistant Director of Traffic, District of Columbia, Washington, D. C.; J. W. A. Bollong, Traffic Engineer, Seattle, Wash.; H. C. Dickinson, U. S. Bureau of Standards, Washington, D. C.; Chas. G. Gonter, Traffic Engineer, St. Louis, Mo.; Maxwell Halsey, Traffic Engineer, National Bureau of Casualty & Surety Underwriters, New York, N. Y.; E. B. Lofferts, Public Service Department, Automobile Club of Southern California, Los Angeles, Calif.; Burton Marsh, Traffic Engineer, Philadelphia, Penn.; G. A. Schuldt, Residing Magistrate, Police Court, Washington, D. C.; Hawley Simpson, American Electric Railway Association, New York, N. Y.; Russell Wise, Chairman, New Jersey Traffic Commission, Trenton, N. J.

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Road Builder Must Subdue Four Forces

Wherever vehicles move on roads, they exert four destructive forces Abrasion, Suction and Shear, Impact, which must be met and overcome by the road builder. How these four forces work was shown in a series of posters by the Bureau of Public Roads at the recent Road Show in Detroit.

Abrasion is the force which grinds down the road surface if permitted. But abrasion has been conquered by fitting the former steel shod grinders with rubber shoes. Less than 5 per cent of American vehicles now move on steel tired wheels. As a result a coat of paint will last a year on our most heavily traveled pavements.

But though rubber tires vanquished abrasion, they brought suction, the force which lifts into the air and disperses the finer particles of surfacing material. This force made the old water bound macadam roads useless, and it quickly destroys gravel roads. The loss of gravel and the dangerous dust clouds which accompany it can be cheaply prevented by treatment with bituminous material. "There is no excuse for a dusty road," says the Bureau.

Shear is best illustrated by a solid tire wheel cutting ruts through an earth road softened by rain. Rigid pavements of concrete or other materials on a concrete base have ample strength to resist shear. Gravel and similar surfaces need firm subgrade laid on a firm, dry soil." Shutting out rain by a waterproof surfacing is not enough. Water must be kept from entering the subgrade by proper drainage and the use of non-capillary soils. If there is silt or other soil with wick-like properties, these must be removed and replaced with other soils.

Impact is the pounding of wheels on the road surface. If roads were as smooth as a billiard table, and all wheels perfectly round, there would be no worry over impact. But a slight roughness of the road, or small obstacles, may cause an impact much greater than the actual weight of the load. There are two impacts, the shock impact, which occurs when the wheel strikes the obstacle, and the drop impact, when the wheel again falls to the surface.

Street Construction and Maintenance

Practices in Small Cities

By S. W. HODGIN
City Civil Engineer, Richmond, Ind.

THIS paper will be directed solely toward explaining the practices that have been in effect in my own city of Richmond. Some of these practices have been followed for many years and have proved their worth, while others are new and experimental only.

Richmond is a city of 33,000 population, with about 88 miles of streets, divided as follows:

	Miles
Asphalt	5
Brick	7
Concrete	16
Bituminous Macadam	5
Water Bound Macadam	20
Gravel	22
Unimproved	13

With the exception of the very heavy traffic on the nine state highway routes within the city, the traffic on the improved streets is very uniformly divided and moderately heavy. As to their condition, I believe our streets are above the average for cities of Richmond's class and show the result of economic maintenance and consistent construction programs.

Prior to 1891, practically all of the usable streets of the city were of untreated gravel. Beginning with that year, a street improvement program was started, and has been carried out religiously ever since, until at the present time 85 per cent of all streets are paved.

The cost of such improvements is now assessed against the abutting property in accordance with the Barrett Law. Richmond, being a third class city, is permitted to assess all of the improvement against the affected property, or the city as a whole may assume a part of the cost. In some cases, the city has paid for the intersections. The decision as to the city's assuming any of the expense lies with the board of public works and is influenced by the importance of the street to be improved and value of the property benefited.

At least three types of pavement are advertised and the type selected is left to the choice of the affected property owners.

Reconstruction of Gravel Streets.—Since construction problems are so similar and the work usually done by contract, it would be impossible to add much information of interest by describing our construction practices. These are well defined by law and must be followed. However, there is one form of reconstruction of gravel streets which was followed at one time that might come under the head of construction work, inasmuch as the work is somewhat more elaborate than ordinary surface treatment. Several years ago many worn-out gravel roadways were so rebuilt. In each case the surface of the roadway was scarified to a depth of about 3 in. and 5 in. of new, bank-run gravel added. This was thoroughly harrowed, shaped, wet, and rolled to the desired crown and finish. With the final rolling, the surface was brushed by means of a steel brush attached to the roller, thus filling the voids in the larger aggregate and giving the surface a smooth finish. Before further treatment was given, the roadway was permitted, if possible, to stay open to traffic until the succeeding year in order that it might be thoroughly compacted.

After thorough compaction under traffic, all depressions were filled with patch material and the proper contour of roadway re-established and surface swept clean. Following surface preparation as above, the roadway was treated with cold Tarvia B by means of a pressure distributor. For the first treatment, about ½ gal. per square yard was applied and, after a short time for setting, the street was thrown open to traffic. After the entire roadway had become well compacted by traffic, a second application of about ½ gal. of Tarvia B was made. In most cases a covering with a moderate amount of chips or pea gravel was applied, after the second application.

Streets constructed in this manner have been in use many years under moderate traffic and have given the utmost satisfaction. The first cost of this type of reconstruction was about 40 ct. per square yard. The maintenance cost is very light.

Maintenance Problems Many.—Our maintenance problems are many and present many interesting cases. About 42 per cent of our streets are either gravel or water bound macadam. One seeing most of these streets now, however, would not recognize them as such. Prior to 1912, such streets were maintained as originally constructed, either by the addition of gravel or by scarifying and re-rolling the macadam. They would become, of course, very dusty and require frequent sprinkling in the summer time to allay the dust nuisance. To overcome this nuisance, the practice of treating the roadway with road oil was started. This work was first done under petition of the residents of any particular street and was paid for by subscriptions from such petitioners. Such treatment acted only as a dust palliative and frequently resulted in the street's getting into worse condition than had nothing been used. The oil seemed to destroy the actual bonding quality of the gravel and, in wet weather, formed an objectionable, greasy mud.

About 1917 was started the practice of surface treating our gravel and water bound macadam streets with the higher grade bituminous materials. The streets first treated were those that had been built and used for many years and had therefore become well compacted so that it was not necessary to build a base.

The first treatment, similar to the construction described above, was, and still is, to shape the untreated roadway to proper contour, filling all holes with patch material, cleaning the surface of dust and applying, with pressure distributor, a penetrating bitumen in sufficient amount to form a moderate depth of coated material, usually from ¼ to ½ gal. per square yard being used. On this surface, after blading or dragging, if necessary, is spread stone chips or pebbles in an amount of about 10 lb. per square yard. In some cases, after

a short time, the street is thrown open to traffic as above treated. In others, it is found desirable to blade or drag the roadway again and give the surface a second treatment with a lesser amount of bitumen.

Retreatment Practice.—After a gravel or macadam street has been treated as above, it must be surface treated periodically as conditions may require. The period of retreatment varies from 2 to 5 years, depending upon the condition of the original base and traffic handled. For this resurfacing the general practice is to thoroughly clean the paved surface and apply about 10 lb. of stone chips or pea gravel per square yard. On this is applied, from a pressure distributor, from 0.15 to 0.25 gal. per square yard of bituminous material, heated to proper temperature varying from 200 to 300 deg. F. In some cases, the stone chips are spread after the application of bituminous material. The latter method has some advantages in that traffic may be admitted within a short period without the surface being picked up. The first method appears to give a better coating of the chips. This maintenance treatment costs from 4 to 6 ct. per square yard or about 1½ ct. per yard per year.

A majority of our streets are so treated and are always in practically as good condition as our paved streets. By treating the roadway more frequently with a minimum amount of bitumen seems to keep the street in better condition at all times than by heavier applications at less frequent intervals. By following this practice no trouble has been experienced with surface corrugations.

During the past few years, we have done considerable resurfacing of old pavements that had gotten very rough or were disintegrating under traffic or from weather conditions. With this class of work we are still experimenting and I am frank to say we have not yet decided upon the 100 per cent job.

Resurfacing With Hot Mix and Rock Asphalt.—That portion of Main Street from East Fourth Street to East Twentieth Street, a distance of about 6,000 ft., was paved with brick in 1892 and 1893. This street is a part of State Highway No. 40. Standard Canton paving blocks were used and laid on an 8-in. stone base, the pavement extending over a double track electric railway. The original pavement cost was assessed against the abutting property, the city paving for the intersection. The brick surface had served its life and had become rough, and was very expensive to maintain. A life of 38 years indicated excellent initial workmanship and firm foundation. On account of the rough surface, it was deemed necessary to improve it.

After much consideration as to what should be done and how payment should be made, it was decided this year that the existing pavement should be retained, patching it where loose, and the entire surface covered with an average of about 1¼ in. of surfacing material. The work was to be done by the street department and paid for out of its budget money. The original program was that a portion only of the street, as determined by the funds available, would be surfaced by applying ¾ in. of hot asphaltic plant-mix, made by a local contractor, and this covered with ½ in. of rock asphalt.

The plant-mix consists of asphalt-coated No. 6 stone chips or crushed gravel, dried and heated to a temperature of about 350 deg. F. The asphalt that proved most successful was Trinidad Lake heated to about 300 deg. The mixing of the asphalt and aggregate is done in a pug mixer, a small amount of limestone dust being added to each batch as filler. The hot-mix was hauled to the job from the plant in trucks covered with tarpaulins to conserve the heat.

First the pavement was thoroughly cleaned and painted with a coat of emulsified asphalt. Three-fourths inch of the plant-mix was then spread, at a temperature of about 200 deg., raked to proper contour, and thoroughly rolled. On this the ½ in. of rock asphalt was spread and again rolled with the equivalent of about a 7½-ton roller.

This was done for only about one-fourth the entire length of the street, since, with the funds available, it could not be completed without materially curtailing other street work. The work proved so satisfactory to the public generally that there was a demand that the entire improvement be completed this year. Funds for the entire improvement with the rock asphalt top could not be raised. However, the plant-mix was applied for the entire stretch and the street thrown open to traffic as soon as rolling was completed. One of the advantages of using plant-mix material is that any portion of the street need be out of service but a few hours.

This improvement, which cost $0.62 per square yard for the single course of hot-mix and $0.92 per square yard for the combined hot-mix and rock asphalt, has been in service for seven months and gives evidence of being very satisfactory. Along the street car rail, where the surface material was feathered out to a thin layer, it is chipping off in a few places. This, however, was expected and these spots, as well as others which we anticipate, will be patched with rock asphalt as may be needed.

Laying Bituminous Top.—In 1916 there was built a concrete pavement, under the 3-mile road law, which is now part of our street system. For the past three or four years, this pavement had been disintegrating badly, each winter adding to its destruction. In order to save it from further disintegration, it was decided to cover the concrete with a bituminous top, the work to be done jointly by Wayne County and city employees.

First a 4-in. layer of No. 2 stone was spread, shaped, and rolled to proper contour and compacted to about 3 in. This course was 20 ft. wide, though the concrete was but 18 ft. After rolling, the stone was penetrated with 1¾ gal. of tar Tm per square yard, chipped with No. 6 stone, and dragged until the voids were well filled. By the addition of more chips and cut-back asphalt, a total of about 2½ gal. of bituminous material per square yard was applied.

In order to close, or seal, the surface voids, a final application of 10 lb. per square yard of rock asphalt was made and this well rolled. This final treatment was very effective and produced a fairly smooth surface, without having the appearance of a rock asphalt finish. This pavement, part of which is now a state highway route, has been in service under fairly heavy traffic for over a year and gives every evidence of standing up. The cost was $0.93 per square yard.

Resurfacing with Rock Asphalt.—In 1926 brick pavements on Fort Wayne Avenue and North D Street, constructed in 1904 and 1911, respectively, were resurfaced with rock asphalt. The old pavements were first cleaned and given a paint coat of cut-back asphalt. On top of this was placed ¾ in. of rock asphalt, which was thoroughly rolled and compacted. In general, this resurface has been satisfactory, scaling off only over the street car tracks, which existed in the center of the street, and in a few other spots where the brick pavement was not thoroughly dry and clean before the paint coat was applied. This resurfacing cost about $0.75 per square yard, the work being done by the street department.

Securing a Non-Skid Surface.—About 10 years ago the Indiana State Highway Department rebuilt a por-

tion of U. S. 40, the National Road east of the city, by the penetration method, applying from 8 to 12 in. of stone penetrated with the equivalent of A2 asphalt. The road was built to a crown of 15 in. in a width of 46 ft. between curbs, with a single track traction line in the center. An excessive amount of asphalt was used which resulted in bleeding and causing a very slippery surface in wet weather. This surface condition, with the excessive crown and traction line rails, presented a very dangerous situation. Many accidents occurred, due to cars skidding. This stretch of road was taken into the city in 1929, the city thus falling heir to the problem of correcting the dangerous condition. Frequent applications of stone chips were made to this pavement in an attempt to establish a surface that was not slick. This was effective for a short time, but on account of the excessive amount of bituminous material, the stone was forced down and the surface again would become very slick. This treatment also increased the already excessive crown.

Had there been no standard concrete curbs and gutters, it would have been possible to build a top on the existing pavement and thus secure a non-skid surface. It was decided to scarify the surface and cut down the thickness of the penetrated stone course by about 3 in. and then construct a new surface that would not get slippery in wet weather. This was done by using a "rooter" to break up the penetrated stone base. The work being done in cold weather, the asphalt binder was brittle and crumbled readily. The 3-in. excess of stone was hauled away and applied to other roadways where it could be used to advantage in base building. After being cut down to grade, the remaining coated stone was shaped to proper contour and rolled with a 10-ton roller until thoroughly compacted. The surface was then coated with emulsified asphalt in an amount of one gal. per square yard. On this was applied a 1-in. course of the plant hot-mix asphalt made by the local contractor. After thoroughly rolling and sanding the surface, this pavement was at once thrown open to traffic. This surface is as non-skid as it is possible to make and seems to have corrected the dangerous condition, no more trouble so far having been experienced. This work cost about $0.82 per square yard and in the aggregate will amount to about $1400. Payment is being made from the city's general fund by special appropriation of the council.

In resurfacing our pavements, we have attempted to do the work without destroying the old base. A base that has been compacted by years of use is as good as any that can be built new and certainly should not be disturbed without good cause. As stated in the beginning, we do not consider our work the last word and we are open to new innovations and are willing to try anything once.

Acknowledgment.—The foregoing is a paper presented at the 18th Annual Purdue Road School.

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Motor trucks are hauling approximately 15 per cent of the total shipments of fresh fruits and vegetables transported 20 miles or more to market. This was determined by the U. S. Department of Agriculture in a recent survey.

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For making icy pavements skid-proof the maintenance department of the Indiana Highway Commission prefers to use cinders with which they mix about 50 lb. of calcium chloride per cu. yd.

Locating a Highway Is Big Part of Improvement Job

Selecting Best Route for Permanent Road Involves Careful Study of Many Problems

[This is the kind of material that counties and states should release to local newspapers in the counties.—*Editor.*]

FIXING the permanent location of a trunk highway is the most important work the Highway department has to do, according to Commissioner C. M. Babcock. The right-of-way and grading are the most permanent parts of the road, and it is essential that the best location be selected. Skimping on expenditures for surveys may result in a large increase in construction costs. Proper location of the road saves money to road users.

When you see a crew of state engineers making a survey, it is no sign that a new highway will be built immediately, or that it will go where the stakes are set, according to Mr. Babcock. The presence of engineers often leads to erroneous reports as to the time certain routes will be improved and the place they will be located, and such rumors have caused some communities needless worry.

Stakes are no indication where the road is going. Preliminary surveys may be made of several tentative routes. This information is necessary in determining the best and most economical route. Drainage surveys and land surveys are often necessary, and require the engineer to cover considerable territory on both sides of the route.

When the engineer's reports reach the central office, computation is made of the dirt to be moved, bridges and culverts needed, cost of right-of-way, etc. Steep hills, swamps, railroad crossings, farm buildings and groves, connecting roads and streets, scenic features, and snow conditions, are all factors to be considered. If traffic on the route is heavy, expensive construction may be undertaken to save a mile or half mile, while if traffic is light, a slightly longer and less costly route may be chosen. Both local and long distance traffic must be considered.

Sometimes the survey shows the cost of the project greater than anticipated, and the plans may be filed away until more funds are available. Or a resurvey may be ordered. Frequently by running several lines and selecting the best route, the saving in construction costs will be many times the cost of the survey.

In addition to engineers assigned to location work the year around, others who supervise construction in summer make location surveys in winter. Making a survey and preparing plans for a construction project requires several weeks, sometimes months. The department aims to keep its plans and surveys well ahead of actual construction.

Curb Radii at Intersections

As in most problems involving the regulation and control of traffic, a discussion of curb radii at intersections should consider two distinct and often opposite points of view—that of the automobile driver and that of the pedestrian. Street improvement for the needs of vehicular traffic has progressed, in most cities, to the point where it is of course obvious that wide curb returns are not only advantageous but necessary for the smooth flow of vehicles. It is equally obvious that as

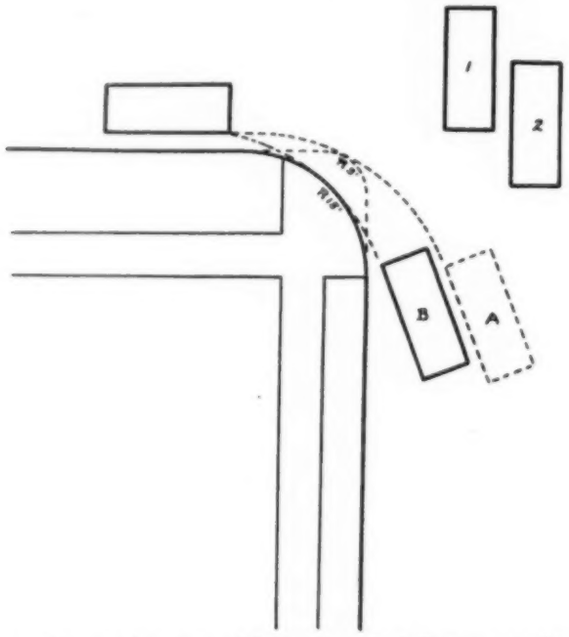

Fig. 1—Shows Advantage of Increasing Curb Returns on Street Carrying Two Lanes of Traffic

the radius of the curb is increased the speed of the vehicles making the turn increases with a resultant rise in hazard and inconvenience to the pedestrian. Because of the numerous factors involved and the lack of reliable data the actual increase in hazard to pedestrians in relation to curb radii is mostly speculative. It is well known, however, that a wide curb return in a heavily travelled business district seriously inconveniences pedestrian traffic in that it reduces the available sidewalk space. This disadvantage can be offset by cutting the corner of the building which not only increases the space for pedestrians but materially improves the motorist's view across the intersection. As most heavily travelled intersections in business districts are under automatic signal control the speed of vehicular traffic is such that the hazard to pedestrians occasioned by right turns can be disregarded, and, if provision is made for ample sidewalk space, the question of proper curb radii can be considered from the point of view of the automobile driver.

In general it may be stated that the proper curb radius is one that will at least allow the turning vehicle to proceed in its new direction withouut interrupting more than one moving lane of traffic. Where there are unusually wide streets a turn can often be made around a short radius without interfering with oncoming traffic but the turning vehicle is forced to measurably slacken its speed. Thus, although a turn can be made without delaying the main stream of traffic, the curve should be such that a vehicle can negotiate it at a reasonably rapid pace.

Most automobiles can turn on a radius of 25 ft. or under. Assuming 25 ft. as a standard, Fig. I shows the advantage of increasing the curb returns on a street carrying two lanes of traffic in each direction. The dotted line indicates a curb of 5 ft. radius. In turning this corner the car finds itself in the position "A" and has interrupted the progress of, not only car Number 1, but of car Number 2 as well. The same car turning the corner on a 15 ft. radius is in the position "B" after completing the turn and has delayed only one lane of traffic as it is not necessary for it to pass into the path of car Number 2.

As very few drivers utilize the full turning capacity of their cars it is probable that on a street about 30 ft. wide between curbs a wider curb return than 15 ft. would be desirable. At intersections controlled by automatic traffic signals or 4-way boulevard stop signs and where the free flow of vehicular traffic is essential, a curb radius of 30 ft. is becoming the standard practice in Los Angeles.

Figure 2 shows a corner with a radius of 30 ft. and the corresponding cut back of the building which formerly was flush with the property lines. Had the corner of the building not been cut back the space left for pedestrian movement would have resulted in serious sidewalk congestion and inconvenience. Such a corner can either be cut back or arcaded. It is obvious from the sketch that this corner offers a much better visibility for approaching motorists. Where it is necessary to install a wider curb radius to allow room for the passage of automobiles between turning street cars and the curb the building is usually cut back on three angles as shown by the dotted lines in Fig. 2. Wherever possible curbs should be arranged to allow the free movement of automobiles between turning street cars and the sidewalk.

In residential districts or areas where traffic is light it is good practice to cut corners back on a radius equal

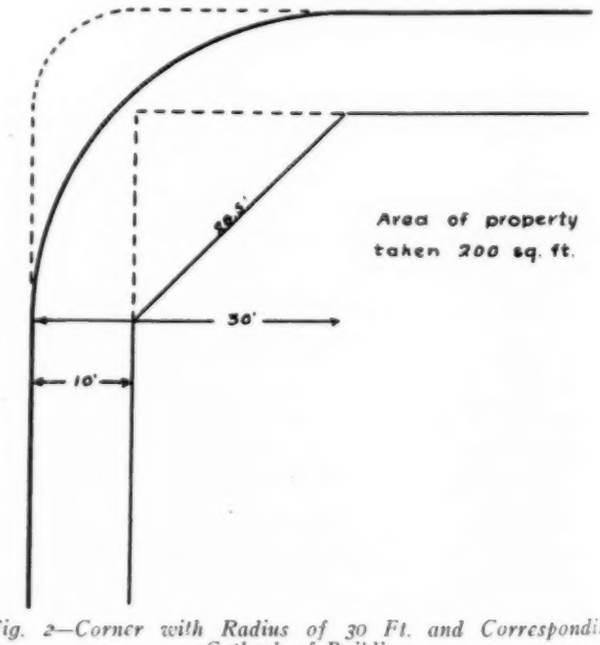

Fig. 2—Corner with Radius of 30 Ft. and Corresponding Cutback of Building

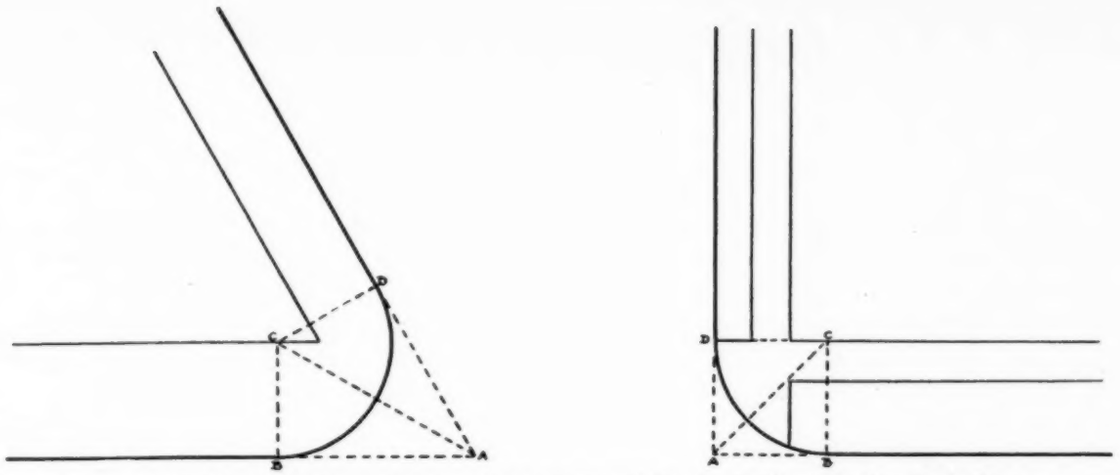

Fig. 3—Illustration of Method of Determining Geometrically the Radii of Cutting Back Corners

to the width of the wider sidewalk and parking. This does not materially affect the sidewalk capacity and offers a safer and better accommodation to vehicles. Figure 3 illustrates the method of determining these radii geometrically.

At intersections of state or county highways a higher degree of safety and convenience may be obtained by laying out and paving between the roadways on a radius of 30 ft. or more. As most highways are considerably less in width than city streets the practice of providing a wide turning radius will eliminate the difficulty shown in Fig. 1 and thereby greatly reduce accident hazards. It is of course very desirable to cut back banks or corners of buildings for the purpose of increasing the range of vision of the automobile driver.

Because of the varying factors in different localities, it is impossible to set down definite standards for the length of curb radii. Each intersection should be studied and a radius selected which will most nearly offer all the desired advantages.

Acknowledgment.—The foregoing is a section of the report the Committee on Traffic presented at the 1932 convention of the American Road Builders Association.

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Constitution of Minnesota Limits New Trunk Highways

Recent reports showing the accomplishments of the Minnesota Highway department in grading and surfacing trunk highways in 1931, together with the program for 1932, have led to speculation on the possibility of adding new routes to the system. The constitution provides that the Legislature may add new routes when at least 75 per cent of the total number of the miles embraced in the original system "shall have been constructed and permanently improved."

Commissioner C. M. Babcock, however, calls attention to another provision in the same section, which says that:

"No such new routes shall be added until and unless the funds available for the construction, improvement, and maintenance of such additional routes shall be sufficent therefore in addition to the construction, improvement and maintenance of the several routes hereinbefore specifically described."

"This makes it clear that whenever new routes are added, no more can be added than can be properly improved and maintained with state funds," Mr. Babcock says. "The routes in the original system which have not yet been permanently located or graded have a claim on construction funds ahead of any new routes which may be added to the system. There are a number of roads throughout the state which form important cut-offs or connections between existing trunk highways, and which should be added to the system as soon as feasible. Among these are the routes of the trunk highways through the three large cities, where the state highways now end at the city limits. But when new routes are added, it should be only those carrying a large proportion of through traffic. Roads which carry mostly local traffic should remain under local control. If an attempt is made to add too many routes to the system, the provision of the constitution quoted above may be invoked, and the entire list declared void."

Mr. Babcock stated that at the end of the present year the department expects to have 2,300 miles paved. The constitutional limitation, however, does not specify paving, but the words "constructed and permanently improved" are generally taken to mean permanently located, graded, and surfaced in a manner adequate to serve present traffic and any traffic increase which may be reasonably anticipated in the near future. On routes where traffic is light, a graded road, graveled or bituminous treated, may be sufficient to comply with this qualification, but on some other routes, where traffic is very heavy, present two lane pavements are already inadequate, and widening will be necessary before they can be classed as "permanently improved."

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Low Oil and Tar Prices

Minnesota will get its bituminous road material at lower prices this year than ever before, according to figures given out by Commissioner C. M. Babcock. Bids were taken a week ago on 12,034,000 gallons of road oil, tar and asphalt, for use on 354 miles of new treatment and 1,065 miles of retreatment.

Prices on material were quoted in tank cars at station nearest the job. Low bids on No. 1 oil averaged 4.35 cts. a gallon compared to 4.92 a year ago. On No. 2 oil the average was 5.41 cts. this year and 5.83 cts. a year ago. On tar the average was 8.80 cts. a gallon this year and 9.66 cts. a year ago. Asphalt prices averaged 6.46 cts. this year and 8.42 cts. last year.

Low bids on application, including hauling from tank cars and spreading on the road surface, averaged .972 of one cent a gallon this year compared to 1.18 ct. in 1931.

Road Conditions in European Countries

By ARTHUR E. MORGAN
President, Morgan Engineering Co., Dayton, O., and Memphis, Tenn.

DURING the summer of 1931 Mrs. Morgan and I covered about 7,000 miles by automobile in Europe, mostly in the central and eastern portions, and had excellent opportunity to observe road conditions.

In France the roads are excellent. The main highways, especially those radiating from Paris, were laid out for military purposes, largely by Napoleon, I believe. They include more long tangents than are met with even in America. I am told that Englishmen come to France with their cars for the opportunity of having a long enough stretch of straight road to get up speed.

Switzerland also has fine roads, and gives evidence of very careful and intelligent maintenance. This intelligent maintenance, rather than high first cost, seems to explain their general excellence.

The same holds especially true in Austria. Except for a main line south from Vienna, there are few concrete roads, but the macadam and bituminous roads are so well cared for that one can travel comfortably in most parts of Austria. In Austria for the first time we met on a large scale the excellent stone masonry which is characteristic of the regions further south.

Road Work Instead of the Dole.—In observing road work in Europe one gets an impression that it is conducted in accordance with a different political and economic philosophy than is the case in America. With us it is assumed that the government must set a standard of high wages on public works. As a result, in times of depression many public works must be given up. In Austria, Greece, Italy and some other countries, public work on the roads seems to be looked upon as a substitute for the dole or unemployment relief.

The philosophy seems to be that people must not be allowed to starve, and that if they are to be supported at public expense, they might as well be working for the public. There is thus a great amount of road work going on, even in countries that are hard pressed financially. Workmen on the roads have the satisfaction of being productive to their country, and not simply being supported in unemployment. As a result the road system of some very poor countries steadily improve from year to year, the public money goes a long way, and the degenerating effect of the dole is avoided.

It is partly as a result of this policy that one finds so much excellent stone masonry. Austria, Italy and Greece lack coal for making cement. Instead of importing cement for masonry, therefore, local labor is used for building walls and bridges. The wages are low, but almost the whole cost of road building goes into labor. Fine stone masonry, such as would be a luxury in America, is found everywhere.

Southern Germany (Bavaria) in general has good roads. Some of them are finely built concrete highways, equal to the best in America. One suspects that they represent to some degree the free spending of borrowed money after the war. But in Bavaria, too, there seems to be a highly developed art of making public works take the place of unemployment doles.

Czechoslovakia Undertaking Large Program.—We were informed that the roads would prove to be very bad in Czechoslovakia. To some extent this was true, though we travelled nearly a thousand miles from the northwest to the southeast of the country, and found much good road, more that was passable, and an enormous amount under construction. One got the pression that the whole of Czechoslovakia had decided to have a modern road system within a year. In general the grading for these roads, including alignment and gradients, is reasonably good. We saw much waterbound macadam being built which in our opinion would need resurfacing so soon that the results would not be very satisfactory. On the whole, if this enormous program of road building in Czechoslovakia is carried to completion, within a year or two the country will have a road system better than those of many American states.

The Roads of Roumania.—Then we came to Roumania. A few peasants cracking stones by the roadsides with their little hammers, a little patch of road repairs here and there, were about all the evidence we saw of benefit to the people from a backbreaking load of taxes. Take for instance, the question of bread. Wheat is one of the principal exports of Roumania. The government can therefore find some money by placing a heavy export duty on wheat, leaving the farmers even worse off than in America. The miller who grinds wheat must pay a heavy tax for running his mill. The merchant who sells the flour must pay a merchant's tax, and finally, of the retail price of a loaf of bread, about a quarter is the tax the baker pays the government. Scarcely anywhere else does the taxpayer get so little for his money.

In travelling 100 miles on one stretch of the main national highway during the middle of the day, the only auto vehicles we met were two small auto busses. Everywhere the roads were bad, but in many places much worse. We covered a thousand miles in Roumania, but only in the western half. I cannot speak for the eastern part, but was informed that the western part had the more passable roads, left over from the days of the Austrian Empire. (Roumania was more than doubled in size by the peace treaties.) Everywhere we travelled over the remains of road that once had been good, but had gone to pieces from want of care.

Class A Bridges on Class X Roads.—But we came across a curious phenomenon. Travelling along a miserable road in great disrepair we would come to a stream over which was being built a massive steel bridge, a class A bridge for the heaviest highway traffic. At first we thought we were witnessing the first steps in a great road building program. But we learned that these are reparations bridges, being built and paid for by Germany, under the terms of the peace treaties.

In the city of Cluj we observed pairs of great steel towers being built along the two banks of the stream that runs through the city. These towers were being connected across the river at the top by lattice girders. It appeared that a transmission line was to be carried through the town suspended from these girders over the middle of the river—another use for "payment in

kind" by Germany. I pictured the havoc when the first high flood should drive debris against these unprotected towers, and thought that a little more engineering and a little less "payment in kind" might have been a better balance.

Concentration of Funds on a Few Roads.—Next we came to Hungary. Like the clay corn lands of Central Illinois, the plains of Hungary either have excellent roads, or are buried in the mud. We went the length of the country on an excellent road, mostly new, high grade concrete highway. Some of the byroads or secondary roads are fair, but at other times where we undertook to explore them we regretted our rashness. Some of the farmers along the way told us that the Auto Club of Hungary was responsible for the policy of concentrating the road funds on a few magnificent highways, leaving the rest of the country in the mud. We did not see enough of Hungarian roads to judge the truth of this statement, though we travelled the entire length of the country from east to west, but the statement tallies exactly with what we saw and heard in other directions of the essentially fuedal spirit that rules Hungary.

Much Road Work Underway in Italy.—Through Austria again we came to Italy. With little basis for my prejudice I had thought of Italy as a backward "Mediterranean" country. But Italy is very much alive. In general the roads are good. One got the impression here too, that public work sometimes takes the place of the dole, and that it leaves better results. There is much road work going on in Italy, despite her difficult financial condition.

There are a few very fine concrete roads, as from Rome to Naples. There is also a great deal of bituminous road. Yet to a large extent, in Italy as in Austria, moderately good surface with constant maintenance is relied upon.

There is great diversity of construction policy in Italy. We saw men sitting by the roadside cracking little stones with their little hammers, and we also saw modern crushers and other modern road machinery. And everywhere we saw the fine stone masonry, the work on little country roads being of a quality that one would seldom meet in America except occasionally in private estates or public parks.

Italy is a young, vigorous country, and the world will hear more of it in the near future. As a retaliation to extreme American tariffs, the import duties on automobiles has recently been raised to 150 per cent of the manufacturer's price. The import and assembling and general agency plants of American automobile firms are thus reduced to service stations for the cars already in use, and a fine growing business has been destroyed. One difficulty with the situation is that by the time American tariff makers wake up to the results of their tariff policies, Italian factories will have enlarged their capacities to meet the home demand, and public policy will demand that these "infant industries" be protected, even though America can make cars better and cheaper. We shall find it difficult to unscramble our tariff egg.

From Italy we went to Greece, shipping our car with us. In inquiring for freight rates, having observed the small size of some European cars, I conservatively estimated our little car as "medium size." I was surprised when I came to pay the bill, that in Europe a Chevrolet or a Ford car is classed not as a small or as a medium sized car, but as a large car.

The Roads of Greece.—In natural beauty Greece is not surpassed by any country in Europe. Given good roads, good hotels, and good sanitation, it should be a delightful place for touring. During the recent dictatorship a large sum of money was spent in road making. This consisted chiefly in the construction of a grand concrete highway from Athens to Eleusis, a distance of fifteen or twenty miles. (The Dictator's home was at Eleusis.) This was the ancient "Sacred Way" from Athens to the temple of Eleusis. One could see where the grading of the new road had cut through the old "Sacred Way," under the accumulated hillside wash of 2,000 years. The rest of the nation remained in the ruts. Under Venizelos the government of Greece is probably on a higher plane than for two thousand years, which is not an extravagant statement as might seem. A great program of $45,000,000 for road building is under way.

If all this money were actually in the bank available for use, the present program might be sound. But if only a third should prove to be available, the results might be sad. Everywhere we saw road building under way, but we saw very little even nearing completion. A vast amount of grading has been done, and for hundreds of miles crushed rock is piled along the roadside. Should available funds be insufficient to complete the work now under way, the results would be much less desirable than though a smaller part were actually finished. The total program calls for 3,000 miles of roads. About 1,000 miles are under construction.

I have heard rumors of grave financial irregularities in connection with these contracts, which were all given to "The Greek Construction Co." to the total amount of about $28,000,000. This company sub-lets to smaller concerns that actually do the work.

The actual work in general seems good. Alignments and grades are comparable to high quality work in first class American highways. Especially I admired the stone masonry of the Greek workman. I compared it with the masonry of the classical period of 2,000 to 2,500 years ago, and in general it compared favorably. The Greek race is very mixed, but frequently in the rural districts one would meet workers on the roads who might have come off of Greek vases of the classical period.

Primitive Methods in Greece.—We found more primitive methods in Greece than anywhere else in eastern Europe. I inclose a picture of men and women breaking stone by hand for road work. A piece of stone, perhaps as big as one's two fists, is held in one hand, and a little one-pound hammer in the other. The stone is struck with the hammer until it is broken into pieces half the size of one's fist. The women earn 25 to 30 ct. a day, and the men 30 to 50 ct. a day at this work. This seems pitiful wages, but a large part of the Greek population has no employment, and these jobs are eagerly sought for. One wonders what the country will do when these loans are exhausted.

In the recent "exchange of populations" with Turkey, a million and a half Greeks were dumped on a country of about five millions. In poverty stricken Greece this was worse than though twenty million paupers had suddenly been thrown onto America. The road building program has been a great help in this emergency.

Greece also has had its "payments in kind" from Germany. When I inquired whether there was a road from Corinth to Patras, along the southern shore of the Gulf of Corinth, I was told that there is no road yet, but that the bridges are all built—by Germany. We did not visit Yugoslavia, but we were told that there, also, one sees great steel highway bridges across streams where passable roads may sometime be.

Effective Speed Regulation

By GEORGE A. EDDY
General Electric Company

OUTSIDE of the congested business areas of large cities, automobile traffic presents to practically every community in the country, the problem not only of providing safe operating conditions for the motorist in general, but also of regulating through traffic to safe-guard local traffic and pedestrians. This condition is nowhere more pronounced than in those communities through which important interurban highways pass; for, in many cases, the highway forms one of the important thoroughfares of the community, where highway speed would be most inconsistent with public safety.

Under conditions such as these, the problem of speed control may over-shadow that of local intersection control, imposing an obligation greatly disproportionate to the requirements of purely local traffic. The authorities in any community thus affected, in most cases having

An electric traffic-signal control unit at this intersection, where a four-lane concrete, interstate highway enters a New York state village, inducts motorists to a progressive flow control system. This system, seconded by alert police officers, provides safe streets for local as well as through traffic without unnecessary delay to either

very limited funds available, must choose carefully the means of regulation which sacrifice neither safety nor economy.

Since in this situation, the greater part of the through traffic will be "foreign" to the interested community (that is, unfamiliar with its physical characteristics and its traffic ordinances), it is obvious that the measures adopted by the community for the regulation of this traffic must be preventable in nature rather than corrective.

It has long been recognized that the use of police officers for traffic regulation is expensive; and that these men were better used in their normal police capacity, leaving the regulation of traffic to one of the many electrical and mechanical automatic control devices now available. Electric traffic signals, and their control apparatus particularly, have reached such a high state of development and their function is so well understood generally that adequate, automatic, "preventative" regulation is now too inexpensive to warrant the use of traffic officers in other than a supplementary capacity.

Traffic engineers throughout the country have determined that under certain conditions the most satisfactory regulation of traffic throughout a travelled area is obtained through the use of individual, automatic, traffic-signal controllers at the street intersections, each correlated with the others to provide that simple and logical form of traffic movement—progressive flow. Some of the features of this type of automatic control are:

1. Vehicles cross the intersections safely at speeds higher than would be permissible in the absence of traffic control.
2. Vehicles are permitted to use the maximum speed consistent with safety and expeditious movement.
3. Continuous movement is permitted, resulting in high average speeds without excessive instantaneous speeds.
4. Congestion at intersections is prevented to a large extent, particularly after vehicle operators become familiar with the system.
5. It is psychologically correct and enlists the coöperation of vehicle operators in the interest of orderly and safe driving.
6. It conforms to modern practice in traffic control, giving the greatest possible flow of vehicles, with a minimum of delay.
7. It is well known to practically every vehicle operator, whose long association with traffic signals has made him extremely critical of any except the most logical type of control.

The features of the modern, individual, intersection controller which make it so eminently suitable for this service are:

1. Adaptability to any intersection and to any location at the intersection.
2. Individual operation, permitting independent initial setting for coördination of timing with other intersection controllers. This gives a continuous flow of traffic regardless of the distance between intersections.
3. Local adjustment of the division of right-of-way between thoroughfares to accommodate the traffic flow at the particular signalized intersection.
4. Operation at an accurate total time cycle, to insure the maintenance of the progressive-movement setting.
5. Provision for the change of total time cycle throughout the area—if it is required to change the speed of traffic flow to suit seasonal or yearly changes in conditions.
6. A device obtainable, when a central coördinating controller is used, whereby the intersection controllers can be checked periodically to insure their continuance on the progressive-movement setting.
7. Simple and sturdy construction, inexpensive to install and to operate.

Automatic traffic control has come to be a widely recognized factor in the use of streets and highways—so much so that many state governments have provided supervisory organizations to prevent the indiscriminate use of inflexible control apparatus which does more harm than good in vehicular movement. It is significant to note that most of these bodies, having determined the minimum volume of traffic which can be handled effectively by an automatic traffic controller under normal conditions, provide that a progressive-flow

traffic system may be installed by any community having the necessity of providing speed control.

A number of competent traffic-control manufacturers, working in conjunction with prominent traffic engineers throughout the country, are now offering apparatus which is sufficiently flexible to assure many years of satisfactory operation. In addition, most of these manufacturers have competent specialists to assist municipal traffic authorities in the selection of the most applicable control system, a service which in many cases will ultimately result in a distinct saving.

Effective speed control is a very real problem to nearly every community; but the means to solve it are available in simple form. It requires only a little application on the part of the traffic authorities, in the interests of long-time efficiency and economy, to insure that the apparatus purchased will meet fully future as well as immediate requirements.

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Federal Aid for Day Labor Projects Opposed

Reasons propounded by the New England Road Builders' Association why they oppose the use of federal aid funds for road construction under the day labor system:

(a) The construction of highways by day labor is wrong in principle because:

It is unjust, unfair and discourages private enterprise.

It compels citizens to pay to be driven out of business.

It usurps the opportunities of capital.

It encourages and creates waste, extravagance, delay, neglect, mistake, irresponsibility, indifference, high costs, and poor quality.

(b) The construction of highways by day labor is inefficient, extravagant, and wasteful of public funds because:

The organization is inevitably overmanned, overpaid, and overworked.

Employees are neither punished for bad work nor rewarded for good work.

Operations are routine.

Responsibilities are indeterminate.

Damages, delays, and costs do not affect the compensation, promotion, or discharge of responsible individuals, nor do individuals benefit by honesty, economies, improvements, or energy.

Positions are often politically routine or otherwise favored and do not depend on merit.

The chief anxiety of a majority, at least, of employees is to get along as easily as possible and to prolong the job.

Official employees are in no way dependent on the economic success of the work.

The quantity and quality of the work done by government employees is less than that done by private employees.

The work is inspected by the same authority that executes it.

Officials in charge are not necessarily expert or experienced.

The work is likely to be fully or partly under political control, compelling the use of labor and materials irrespective of their actual value.

The work is more likely to be defective than contract work where the contractors are usually held to the specifications by rigid supervision and often by drastic decisions that are seldom applied to government forces.

(c) The construction of highways by day labor, even though undertaken in pursuance of a temporary economic theory or policy, will cause a permanent increase in the cost of state and local government because:

Once men are added to the government payroll, it is difficult to discharge them when the particular work for which they were hired is completed, consequently some of them will become permanent additional government employees.

Road building machinery and equipment will be purchased to carry on the work and will have to be maintained in future years.

Day labor operations will be continued in future years in order to keep employed the men permanently added to the public payroll and the additional equipment purchased in pursuance of the temporary policy to conduct work on that basis.

If the Federal Bureau of Public Roads shall for one season become committed to the scheme of co-operating in sharing the expense of day labor operations, it will be extremely difficult, if not impossible, to withdraw, on account of the political pressure that will be exerted to continue the arrangement.

(d) If, despite established records and experience to the contrary, it were assumed that day labor projects could be carried on economically, then no greater local employment would be provided that under the contract system because laws and regulations applicable to public contract work now require that contractors give preference in employment to local citizens. As compared with contract work, day labor operations might cause a shifting of employment from some men to others but would not bring about any greater employment except to the extent that the work would be overmanned, unnecessarily prolonged and uneconomically conducted.

(e) The planning and supervision of highway construction work are essentially governmental functions. The actual construction of highways has become a big private business institution. The government should adhere to its particular functions and leave the actual construction work to private business.

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Old Spanish Road on Exhibit

Part of the oldest transcontinental road in South America has been given to the Rosenwald Industrial Museum of Chicago. And, stone by stone, it is to be laid down in its original setting in the museum, for each stone has been photographed and numbered.

It is known as the Las Cruces road and is one of the two built by the Spanish when they needed paths to carry their gold from the temples and mines of the Indians to the sea.

The Spanish Conquistadors drove the natives across the jungle, laying stone after stone. That was more than 300 years ago. Then, in 1671, came Sir Henry Morgan, English raider. He stormed the castle of San Lorenzo, at Las Cruces. Up the Charges river he sailed with 1400 wild natives in dugout canoes. Coming on the trail, he followed it to Panama, the Spanish capital, burned and robbed the city, and scurried back to the coast.

EDITORIALS

Shall We Redesign Roads?

HIGHWAY and transport engineers observe that road surfaces are now more enduring than formerly. One reason is that highways are better designed, better constructed and better maintained and another reason is the smaller shock and impact from modern balloon tires as compared to old solid tires.

To what extent balloon tires on trucks and automobiles has increased the life and service of roads has not been evaluated.

Airwheels, the latest development in tires, carry inflation pressures less than one-third those of the ordinary balloon tire, and have a much greater contact area for load distribution to the pavement. Shocks from road irregularities are absorbed by them and destructive impacts reduced.

The road designer must now consider these facts and determine, if possible, what economies in surfacing may be effected when and if these new shock absorbing devices predominate.

More and Better Roads

A RECENT statement in *Business Week* to the effect that more and better roads are not needed and the number of automobiles in use is declining, is misleading and may be injurious to the automobile and highway industry.

Statistics for the entire country show that automobile registration did fall off last year a very, very small amount—2½ per cent—but that is not sufficient reason for penalizing an industry that employs thousands of workers.

Our country never has had a sufficient mileage of highways. Statistics show that if automobile registration remains stationary, five years of construction at top speed will be required to build enough roads to properly accommodate automobiles and trucks now in use.

Furthermore, utilization of highways has greatly increased. Automobiles and trucks, as shown by recent traffic surveys and gasoline consumption, now travel more miles per year than formerly. Only a few days ago five truck companies were refused permits to operate on certain highways in Ohio because these highways were already crowded beyond their traffic capacity.

Facts are interesting, but unless fairly interpreted unforeseen injury may result.

Machinery Repairs

MUCH construction machinery now in use is worn beyond the economic limit. Contractors have been endeavoring to keep the cost of repair of their old equipment down by not spending necessary money.

Take an elevating grader and dump wagon outfit for example. Instead of buying a new set of chains for the belt drive in the spring, the old set is continued in service until it is replaced link by link as it breaks on the job. It takes only two or three minutes to replace such a broken link, true, but in the meantime a dollar's worth of output has been lost. It is not uncommon to find outfits laying up in camp because of a worn out pinion or gear rack, or because of a worn out kingpin.

Contractors know these things weeks in advance but they hope the part will last longer and hence do not purchase the necessary repairs. When the worn out part finally gives way under the load of working conditions, the repair then costs the contractor and his men a good deal more than if the repair had been made at the proper time.

Failure to make these necessary repairs at the proper time expresses itself in constantly recurring breakdowns in the busy part of the construction season. Lost working time may easily, and does in this period of close bidding and low profits, convert a profit into a definite loss.

Elevating graders are often continued in service long after they have become so badly worn that breakage is frequent and trouble with the elevating mechanism more or less chronic. Knowing the weakened and worn condition of many parts, plow shakers will naturally lighten up on the bite in order to prevent a breakdown. This produces a definite but intangible loss of output, which far surpasses in dollars and cents the positive time losses due to breakdowns.

Elevating graders were chosen as an example. They are not the only offenders. Practically all construction equipment, especially machinery, has fallen into just this condition during the past two years. Much of the present heldover machinery is obsolete, besides.

The remedy is obvious.

Objections to a Federal Tax on Gasoline and Motor Vehicles

IT is being proposed that the federal government levy a tax on gasoline. This would be an economic mistake. Gasoline is heavily taxed by the states, these taxes being in the nature of tolls for the use of the highways. Motorists do not, as a rule, object to existing gasoline taxes because the funds thus secured are used to build and maintain roads. Moreover, the tax is equitable. But let a federal tax be levied on gasoline and there will arise prolonged and justifiable complaint.

It is strange indeed to witness congressional opposition to a general sales tax, and then to see the eagerness with which special sales taxes are advocated. One might imagine that motor-cars were owned only by the wealthy, for how otherwise can explanation be made of the advocacy of federal taxes on gasoline and automobiles?

In most states motor vehicles pay a substantial license fee which is of the same nature as the gasoline tax—a toll for the use of the roads. Not until such tolls became general did our highway system begin to improve in a creditable manner.

Since federal appropriations for road construction are but a very small percentage of the total expenditures on highways, there is no excuse for a federal tax on gasoline or on motor vehicles. Those taxes should continue to be tolls levied for the use of the highways.

There are countless products upon which federal sales taxes could be levied without causing a noticeable burden upon the buyer. Those things that are now heavily taxed should be exempted from further taxation.

The "soak-the-rich" theory of taxation has brought Great Britain to her knees and has kept her there ever since the end of the world war. Since the capital that pays wages is furnished mainly by the well-to-do, taxation that depletes capital seriously will certainly empty many a pay envelope. Vide England!

County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement

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ROAD-MIX

The Road Mix Operation

Graded Aggregate Type

As Built in District Number Two of the State of New York

***Under the Direction of* A. E. STEWART**

County Assistant Engineer, Oneida County

SEVERAL years ago New York State found itself up against a very heavy road reconstruction problem, in addition to the normal new construction program. The rapid increase in pleasure cars was augmented by the sudden development of fast and heavy commercial traffic. This change in traffic conditions not only called for reconstruction of old inadequately metaled roads, but also called for a revamping of the whole road design. Main lines had to be taken care of first and the program was of such an extent that the secondary roads received no attention, beyond general maintenance work. However, these roads due to their age had passed out of the maintenance stage and had arrived at the point where reconstruction was the only way in which they could be placed in condition to meet present needs. The emergency called for the development of a new type pavement, cheap enough and sufficiently easy to manipulate that the state's maintenance forces could do the necessary construction work with the limited funds and equipment at their disposal.

A type, which after several years of use and observation, seems to fill the requirements best, is a midwest development known generally as "road-mix," graded aggregate type. Briefly the method of construction is as the name implies. Crushed stone was dumped from truck onto the old road surface and given a once over leveling operation by a motor grader. Next bituminous material "T" was applied directly to the stone by a motorized pressure distributor and the resultant mass mixed on the road by blading it from side to side using the motor grader. This operation was repeated several times until the whole mass of stone was completely coated with bituminous material, after which it was spread into place by the grader and rolled.

However, the actual construction of a good pavement of this type is not as simple as the preceding paragraph

Spreading the First Application of Tar

might imply. In the first place a uniform distribution of stone is very important. After trying in all ways to get this by a direct dumping of the stone from trucks to the road surface we found that, although the resultant surface was all right the edges were ragged and uneven, due to the varying amounts of stone per unit of road length. This condition was overcome by the use of a regular hopper stone spreader, into which the stone was dumped, and then spread by drawing it ahead. Not only was the desired uniformity in the spread of stone obtained, but the spreader could be regulated to give just the proper amount of stone required. In addition to this, the stone was left in a condition which required no leveling off before adding the bitumen.

Number two (¾ in. to 1¼ in.) stone was used in sufficient quantity for a finished 2 in. top course. Owing to the fact that it was a washed commercial product, the aggregate was spread sufficiently far ahead to insure a dry condition before the addition of the tar.

The bituminous material was Tarmac P meeting the New York state specifications "T" for heavy surface treatment, Item 73A.

The first application of tar was made at the rate of approximately 0.5 gal. per sq. yd. of finished surface over a 1500 to 1800 ft. section. The large motor grader then bladed the aggregate from one side of the road to the other. The curved surface of the scraper blade gave a tumbling motion to the stone which is very effective as a mixer. After the aggregate was thoroughly mixed it was again leveled off roughly and a second application of approximately 0.5 gal. of tar was sprayed upon it. The mixing operation was repeated and by this time sufficient tar was applied to completely coat the stone. The mixed aggregate was then bladed into a windrow and allowed to stand until the tar had the proper consistency or tackiness, to spread into final shape and not be disturbed by traffic after being so placed. As reconstruction work in this state, whether done by contract or with state maintenance forces, must be conducted with a minimum of inconvenience to the traveling public, instructions are given our men to leave the incompleted mixture in windrows at the close of the days work, or if operations are discontinued for any length of time.

In the final spread of the coarse aggregate, the grader operator worked the material from the windrow in the center of the road, toward the edges. When he had the proper amount worked to the edge, he started blading from the edge toward the center. This is a spreading and leveling operation so only a small amount of the material was carried ahead of the blade. If properly carried out, the operator will have a very small windrow of stone left in the center of the road, which he uses for the final trim.

After using various type of graders, this district favors the heavy motor grader equipped with crawler treads. It has two important advantages, that of improved traction, and absence of ruts at completion of spreading. We also found that the use of two graders very greatly expedited the work. One mixes while the other spreads and levels.

After the final spread of the course aggregate we roll thoroughly, using an eight or ten ton roller. Then ¾ in. stone is lightly spread by hand over the surface, using only a sufficient amount to fill the voids. This is broomed and rolled and in this connection we use brooms attached to the rollers in all the finishing operations. At this stage, we have found it advantageous to allow traffic to kick the choke stone around and throw off any surplus. In two or three days we apply the seal coat which is an application of higher viscosity tar, to the amount of approximately 0.35 gal. per sq. yd. This is immediately covered with ⅜ in. stone, broomed and rolled thoroughly.

The use of two graders has been recommended and where so used it will be found advantageous to use two rollers as one cannot do the work properly and keep the pace.

Rolling in Light Coat of ¾-inch Stone

The results obtained from this type of construction are surprisingly fine. Without doubt the resultant surface is the smoothest obtainable in macadam. The traveling public is very well pleased, both from the standpoint of non-interference with traffic while building, and the delightful riding qualities of the road. From an engineering standpoint it is satisfactory. The fact that a uniform bitumen content is obtained together with the thorough coating of each particle of stone with tar, using relatively less bitumen per cubic unit than in other types, means economy. The speed at which the work can be prosecuted with a minimum outlay for labor and equipment is exceedingly pleasing to the engineering mind. The cost of this road-mix graded aggregate top course has been brought down to nearly $.40 per sq. yd. during the past year. What the life of this type will be, remains to be seen, but from our observations to date we expect a rapidly increasing use of road-mix construction.

The ROLE *of the* County Commissioners *In Road Improvement*

By CHARLES A. WEST
Tippecanoe County Attorney

WITH the passing of time we have witnessed a revolution in modes of transportation and travel. With the motor age came the mighty problems of highways—establishment, construction, and maintenance. Prior to the advancement of modern transportation the highway problem was chiefly confined to the townships, but as traffic increased and the use of the motor vehicle extended to and became an integral part of all business, it soon became apparent that the township could not successfully cope with the situation and keep pace with the ever increasing demands for better highways over which a great part of the business of this country is moving. With the rigid development of the different highway systems, there has also been placed within the jurisdiction of the board of commissioners a greater duty and added responsibility in dealing with one of the greatest departments of our government. Some of them may well be enumerated so we can more readily appreciate such duties and responsibilities.

There are many laws which place certain duties relative to the highways on the board of commissioners and these may be briefly enumerated as follows:

County Unit Roads.—The County Unit Road Law authorizes the board of commissioners to locate, establish, construct, change, or improve and to maintain a highway, whenever a petition is presented signed by 250 or more freeholders and voters of the county, not less than 15 of which shall be from each of the majority of the townships. Under this law the board are the viewers, in fact, the entire matter rests with them, unless a remonstrance is filed by a greater number than the petition contains. This places squarely on the board the great responsibility of not only the decision of whether a proposed highway is of public utility and necessary for the welfare of the community and the traveling public, but of safeguarding the tax dollar of the taxpayer. It behooves every board of commissioners to use the best of business judgment in such expenditures and to disregard efforts made by groups and individuals for special benefits.

Three Mile Road.—The Three Mile Road Law provides that when a petition signed by 50 or more freeholders and voters of a township is presented the board is authorized to construct a highway, not more than three miles in length, unless a remonstrance is filed by a greater number than the petition contains. This law differs from the County Unit Law in that it is confined to the townships and each township must pay for such construction. And again, the responsibility of the board is great and the best business judgment must be exercised. However, this law differs in another respect, that is, on petition filed the board appoints reviewers, two from districts other than the one within which the proposed highway is to be located, the third the county engineer. If no remonstrance is filed and the viewers' report is favorable, it is mandatory for the board to construct the road. This is the law of which we have seen in the press much criticism, some of it just and much of it unjust. In some of the articles which have appeared condemning this law and demanding its repeal, there has been an attempt to convey to the tax paying public the impression that the board of commissioners are entirely responsible for the tax money expended on these roads. This is not true, many times and in fact, in the great majority of cases a petition will be filed containing from 100 to 1,000 names, petitioning for the construction of a road, those against it will not file a remonstrance and will not take the trouble to file an objection with the state tax board, but they will sit idly by and then condemn a board for the construction of the highway. If this law is rightfully administered and not abused, either by the taxpayer or board, it is a good and reasonable law and enables a township to improve a needed highway which could not otherwise be done.

County Line Roads.—A section of the fact makes provision for the establishment, repair, and maintenance of county-line roads by the joint action of the commissioners of the adjoining counties.

Section 8370, Burns, 1926, authorizes the board to construct highways between certain cities.

Section 8415, Burns, provides for the construction of highways on petition of landowners whose land lies within one mile of the proposed improvement.

Section 8433, Burns, provides for the construction of highways where a portion of the cost is paid by special assessment against lands benefited.

Bridges.—The board of commissioners have control of all bridges within the county, except such bridges or culverts on township roads, the cost of which does not exceed over $100.

The changing, locating, relocation, vacating, or opening of highways comes directly within the jurisdiction of the board of commissioners.

Mail Routes.—This law provides that it shall be the duty of the board of commissioners to keep in repair and passable condition all roads over which the mail is routed, and the law provides that on receiving notice that such mail route roads are impassable or in bad repair the board shall without delay improve such roads, regardless of whether there is an appropriation of money available or not, and to pay the cost of same out of any money in the county treasury not otherwise appropriated. This is an exception to the law that expenditures cannot be made without an appropriation being first made and a penalty is placed on the commissioners if they fail.

The Tax Levy.—An important section provides that the board of commissioners shall fix the tax levy for the purpose of raising money sufficient to maintain the county highways. Therefore, we see that it is not only the authorized right but the duty of the board to fix this levy in such an amount as to be sufficient to

maintain such highways but to do so in such a manner that will protect the great investment of money in such highways. There has been some question relative to this law in certain counties, yet it seems clear that this provision is an exception to the general statute which places the fixing of a levy with the county council. Of course, it is always advisable for the board of commissioners and the county council to cooperate and be in harmony in all such matters. At the same time, this is a sound and reasonable law, because the responsibility of the management of the highway department rests on the board of commissioners, therefore, it would be very foolish to hold them responsible for the conduct of the department and then tie their hands by leaving them without the authority to raise sufficient money with which to maintain the roads and protect the investments already made.

Highway Superintendent.—With the creation of the county highway department, a great responsibility was placed directly upon the board of commissioners. This law directs that there shall be appointed a county highway superintendent, who shall have direct charge of the management of this department. This man must be one of ability and experience in this line of work. The day has passed when, as in the old order of things, anyone could go out and maintain a road. He must not only know how to build highways; he must also know how to build culverts and bridges; he must know equipment; and know how to preserve it; he must know how to maintain the greatest number of miles at the lowest cost to the taxpayer. He must be a business man and know how to operate within his budget with the greatest efficiency. And finally, he must know how to handle and train highway men, for today this is a specialized business and he must know how to spend money and get the best results at the least expenditure of money. Therefore, with this in mind, the legislature provided that the board of commissioners should appoint a highway superintendent and that this appointment should be for a period of four years. It is also provided that he can only be removed when he actually fails in the performance of his duties, and this is as it should be, for an experienced man in this department will with continued service become more efficient and save the taxpayers money.

With this appointment, a legal contract is made, and it should be respected regardless of politics. However, we have seen in some counties in this state that because the political complexion of the board has changed, there has been an attempt to not only violate this law but also to violate a contract by filing trumped-up charges in order to bolster up a political machine or at the demand of political henchmen who do not consider the welfare of the department or the taxpayers' dollar. Any commissioners who will be a party to such practices are not only unworthy of the office they hold but what assurance has the taxpayer that they will not violate their oath of office in other matters and prostitute the interest of the taxpayer to further political gain?

Commissioners' Responsibilities.—With the great amount of money invested in county highways, the board is placed under a great responsibility, not only in the construction and maintenance of those highways, in order that modern transportation may be served, and the traveling public may enjoy the best of roads, but to safeguard the tremendous investment of public funds that have been expended on a given highway system. Diligence must be used, not only to maintain such highways to a standard necessary for present and future day transportation but to so manage the business affairs the department in the most economical manner that the taxpayer will receive a dollar of value for every tax dollar expended. It would be folly to expend large sums of money on any given highway system and then neglect to maintain it in such a manner as to protect the investment already made.

In order to give the people the kind of highways which the times demand and at the same time protect the taxpayers' money already invested, sound judgment must be exercised by the board. They must see that the best workable system is employed in the operation of the department. Good, experienced men should be employed and *retained* when they have become efficient in their work. They must be judicious in the expenditure of the tax money in the purchase of material and equipment and in the letting of contracts. They must also realize that the day has passed for political control of the highway department. The practice of bygone years that a highway department should be used to build political machines must be eliminated, for if we are going to continue to enjoy the further development of the highway systems, the soundest of business judgment must be exercised to get results and at the same time conserve the tax dollar.

We readily see the important part which the board of commissioners play in highway development. The time has come when none but the best of business men should be placed on these boards if the welfare of the department and the interest of the taxpayer is to be served.

During the past year, mainly through the newspapers, the various highway departments have been attacked under the guise of a tax relief program. County boards have been unjustly abused, highway superintendents have been unjustly attacked, much propaganda has been put out causing unfavorable comment and dissatisfaction among people who have no way of knowing actual conditions, and who do not take the time and trouble to investigate. Yet, those very people and certain organizations who are responsible for a great amount of unjust criticism are the first ones to appear before the board and insist on the expenditure of money to further either a selfish purpose or a desire to make a showing favorable to their respective organizations. And the same newspapers who are attempting to have the people believe that they are fighting the taxpayers' battle never inform the people that by reason of the enactment of laws favorable to the newspaper industry the cost of useless legal advertising has increased within the last ten years about 100 per cent. Thousands of dollars of the taxpayers' money could be saved on this item alone. Yet, let the people attempt to repeal some of those useless and unnecessary laws, and see what happens.

State Highway Commission.—Another duty of the board of commissioners is to cooperate with the state highway department. The cooperation of these two departments is very essential and until a short time ago it was the duty of the board of commissioners to acquire all the right-of-way for the state roads through and within their respective counties. This, of course, has been changed as the state now acquires the right-of-way.

The state highway commission should be commended for the great work they have accomplished in developing a great system of state roads. They have been gracious and considerate in their dealings with the counties. However, there is one thing with which I must take issue, that is the movement which has been started to place all of the county roads in the state highway system. The chairman of the commission in ad-

vocating this movement stated, that in taking over the 40,000 miles of county highways it would enable the counties to reduce the county tax levy 16 cents. He had been misinformed on this. A check of the tax levy for 1932 in 89 counties shows that the average levy for the road fund is about 7 cents, and out of 89 counties only 8 have a higher levy than 16 cents. Therefore, no such relief could be had.

I do not believe that the state department should attempt to take over these local roads. The greater number of the highways maintained by the county highway department are local in character and serve only the local community within which they are located. There is a local interest in these highways that cannot be served by the state. If there is a real desire to relieve the taxpayer, that is, the real property tax payer, I believe the time has come that the state highway system has been developed and extended until they control about all of the trunk lines of major importance, that this department can successfully carry on its work and protect the investment already made without the use of the great amount of money which has been at their command. Enough of the gasoline money could be paid to the respective counties to enable them to maintain the county highway system and eliminate the local county levy for this department. And I believe that investigation will sustain me when I say that the state cannot maintain these local roads with as low a mileage cost as the counties can. It is a trueism in government operation that any given department with too great an amount of money cannot be operated economically. By absolving all county roads, this department would become too big and it would be endangered in that it would be thrown wide open for political interests to use and build up a mighty political machine. That should not and must not happen.

Acknowledgment.—A paper presented at the Eighteenth Annual Purdue Road School, January 29, 1932, Lafayette, Indiana.

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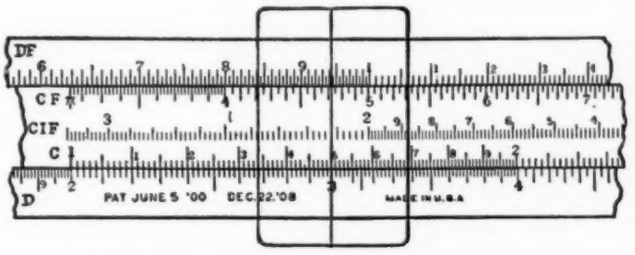
Algebra Is a High-Powered Motor for Arithmetic

The most important thing in algebra is doubtless logarithms, if this branch is to be judged from its practical utility. This is merely a high-powered motor for arithmetic. It speeds up computation, and removes a vast amount of labor, as well as possibility for errors. Students and engineers alike seem to have a tendency to neglect this fine tool, unless it can be said that they use it when they use the slide rule. Perhaps one reason for this neglect is the fear that the trouble of looking up values and interpolating in tables will not be repaid by the saving of labor in computing. There is no excuse for this fear, in the face of modern graphical log tables, which remove all the labor of interpolating as well as most of the chance of reading the wrong value. As for the rest of algebra, the student must be able to solve simultaneous linear equations and quadratics without the necessity of referring to a text. In such solutions, make an orderly arrangement and a numbering of the equations a habit. Indicate what each operation is by such simple statements as "Transpose (3)," "Collect coefficients of x in (4)," "Divide (5) by the coefficient of x^2," etc.

It should be said here that it is useless to be able to juggle equations unless you can originate them, that is, to express relations in mathematical language. Perhaps the ordinary courses in mathematics, from algebra and trigonometry onward, put too little emphasis on this side of the subject. Lack of ability to do this is certainly the most outstanding mathematical deficiency of upper-classmen in college.

Equations involving higher powers of the variables, and equations transcendental on one side and algebraic on the other occasionally arise in practical work. If the computer knows what he is doing he can make a good guess as to what values will nearly satisfy such equations, and then the method of "cut and try" will lead to a solution with surprisingly little labor. In a cubic, one root by cut and try usually leaves two easily found by the solution of a quadratic.



The slide rule provides a graphic method of using logarithms. Multiplication is effected by adding the logs of the two factors. In the slide rule pictured here, all numbers on scale *D* are twice the corresponding numbers on scale *C*. You can pick them out. 3.0 (at the slide), the product of 1.5 and 2; 3.6, the product of 1.8 and 2; 4, the product of 2 and 2; and so on for all numbers on the scale. To the log of 2 (on scale *D*) is added the log of any number on scale *C*.

Let the student be not discouraged if he finds that he has forgotten some of his algebra a year or so after taking, and let him not regret his lost labor in learning it. Skill in juggling equations is invaluable and comes only from practice. It is quite possible for him to be confronted in some actual computation with the problem of solving several dozen simultaneous equations in an equal number of unknowns. This will cause him to compare his formal course in algebra to an introduction to a wall-flower with whom he afterwards has to dance. The strict necessity of conforming to her style makes the analogy quite pat.

"Check and be checked," is the most important phrase applicable to engineering computations. For algebraic work no method beats substituting back in the original equations. Computers are usually paid on a basis of time, rather than the job. This is fortunate.—*Ohio Engineering Experiment Station Circular No. 27.*

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Next to Arithmetic Trigonometry Is Most Useful

Trigonometry, next to arithmetic, is the most useful mathematical tool for the engineer. The computing of projections and the solution of triangles must be reduced to permanent mental impressions. Miscellaneous juggling of trigonometric equations may be of less value, but such equations arise with remarkable frequency in engineering computations. To handle them, the student must recognize the fundamental trigonometric identities on sight. If he knows the identities and the rules for solution of triangles "off hand," he can afford to depend on reference to books for the rest. —*Ohio Engineering Experiment Station Circular No. 27.*

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Suggestion has been made that Michigan mark the routes better through their bigger towns and cities so we dumb drivers can not get lost so easily.

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How to prevent marksmen from shooting out reflectors in danger signs? That's the question.

IN THE WIDE OPEN

BEFORE

This old bridge at Rochester Flat served traffic in 1919

Road in Davis County in 1919 was not so good.

2 HP. automobile on sand road in Kane County

The old road in Emery County was not built for pleasure driving

CARAVAN DE LUXE

By FRANK ENSIGN

IN the forepart of September, 1914, the Commercial Club of Salt Lake City, Utah, instituted a good roads tour to Grand Canyon of the Colorado. The roads of that time were in poor condition and before the party got back we realized we had been on a journey. The party was made up of Mr. Russell L. Tracy, Russell Tracy, Jr., Fred Smith, J. H. and Mrs. Manderfield, Mr. and Mrs. W. F. Jensen, Mr. and Mrs. A. H. Ensign, and Frank Ensign.

The caravan proceeded fairly well to Cedar City, making the trip in two days and eating a great deal of dust on the way. Out of Cedar City I turned off by mistake to the Zion Canyon road and tore out the storage battery from a new Cadillac car trying to negotiate the high rocky centers; at this instance a native told me that mine was the first automobile that had traversed the high centers of the Zion Canyon road.

I put on a new cord tire at St. George and the party proceeded in the direction of Kanab. We had gone but fifteen miles when the new tire blew out; cut in two by a sharp rock. The Pierce Arrow car in the party could proceed but two miles at a stretch before it had to be stopped and the carburetor air strainer cleaned of the accumulated dust on the screen so intense was the dust on those roads.

All the cars negotiated the Hurricane Hill out of Hurricane, Utah, a 27 per cent grade, but we broke several spark plugs in the attempt by rushing an unbridged irrigation ditch at the foot of this nightmare hill. We were the only cars that had ever made the hill without the aid of horses.

Halfway to Kanab the steering knuckle of my car snapped in two from the strain of ruts. We deserted this car on the spot and propped the

Pictures Courtesy State Road H. S. Kerr

SPACES OF UTAH and AFTER

broken knuckle up with an ox skull that happened to lie nearby, and piled our luggage and selves into the remaining cars. Eventually we reached Kanab.

In Kanab we hired a Ford and set out on the last lap of our journey to the North Rim and Bright Angel Point. From Kanab on we had to let the air out of the tires periodically to negotiate wide desert sandy washes and the White car driven by Fred Smith broke its body in half, rushing one of these sandy places. In the middle of the Kaibab Forest the Ford car broke its crankshaft and again we doubled up in the cars.

Mr. Tracy's car took on 10 gal. of wood alcohol at Kanab by mistake and in the forest the alcohol dissolved the shellac off the cork float in the carburetor and stopped up the needle valve with the shellac. We lost a day on account of this mishap. We finally reached Bright Angel Point and took in the wonderful sight which had been well earned.

On the journey back, I bought a new Ford at Kanab and the Ford dealer, Mr. Hughes, agreed to drive it to Salt Lake City, as he had to come in to get another car. Just out of Kanab a desert dust storm enveloped the party and the Ford crashed headon into another car. The driver, Mr. Hughes, suffered two broken ribs in the collision and while rushing him to a doctor, I ran into a twenty-foot deep desert arroyo and barely missed killing myself and passengers.

When we reached home all of the varnish was off our new car, the new tires were worn out and the distributor was clogged with red dust until the electrical system would barely work. The nightmare of this trip is clearly outlined in my memory, notwithstanding the years that have intervened.

The new Rochester Flat bridge replacing one shown on opposite page

Road No. 93 in Davis County

The Mt. Carmel-Kanab highway in 1931

Commission of Utah Chief Engineer

U. S. 91 in Beaver County, between Salt Lake and Cedar City

The Road Builders' News

Construction Congress Plan Approved in Annual Road Builders' Meeting

Approval of participation in the plan to hold a Construction Congress during January, 1933 in some city to be agreed on later was expressed at the annual meeting of the American Road Builders' Association on April 28. All branches of the construction industry will be represented in this Congress.

A membership campaign in which every member would "bring in a member" to enlarge the sphere of influence of the association was endorsed.

The needs, advantages and plan of the Construction Congress were outlined as follows by Charles M. Upham, secretary and engineer-director, American Road Builders' Association, in a special report submitted to the directors of the association:

The Need for the Congress—If the highway industry is to hold its rightful place in the nation's development, cooperation on the part of individuals and associations in the highway field is increasingly necessary under present economic conditions. In this connection the various associations might well consider the holding of one impressive convention or combined construction congress which would attract at one time and place the combined attendance heretofore brought together through individual annual meetings at separate locations. Such a meeting would develop the strength of the united industry and would effect maximum economy for the associations and exhibitors participating. It would at the same time contribute materially toward the accomplishment of the greatest task facing the highway industry today—an intensive educational campaign to justify the expenditure of the public dollar in highways.

Combined Effort Needed—Progress toward this end can be accelerated by organized efforts of a united industry. Improvements in design and methods through experience, exchange of ideas, and research as carried on by the American Road Builders' Association and many other individual highway organizations jointly and severally, are of no less importance than heretofore. They contribute to the normal and essential progress of highway technique and deserve undiminished support. External conditions, however, impose an immediate obligation upon every component part of the industry to rise above individual aims and take its part in an intensive educational effort to assure continuation of highway programs—federal, state, county and city—without interruption, and conservation of highway revenues for highway purposes.

The Highway Investment—The wisdom and economy of investing public funds in highways must be confirmed. Savings through lower transportation costs and the increased convenience and safety of improved roads, as well as social advantages to communities and individuals must be made more widely known. The progress of the industry in improving methods and increasing efficiency and economy of construction, must be translated into terms of value to the taxpayer. The importance of highway operations for the welfare of every community must be interpreted, not only in direct highway benefits but in the increased purchasing power of highway workers resident in cities, towns and villages throughout the land. The thousands of dollars spent for highways and the millions of dollars of wealth that they produce must be more fully recognized. The dissemination of such facts will emphasize the dominant part that highway construction, maintenance and operation, as well as highway transportation, play in the life of the citizens of our nation. Realization of them by the public will sustain and renew enthusiastic interest and justify continued investments of public funds in highway activities.

Coordination of Activities Desirable—Increased effectiveness of individual groups along these lines, the importance of which cannot be overestimated, is possible to a marked degree through a coordination of activities culminating in the combined construction congress. A national meeting of all highway groups in one city during the same week would produce a spectacular impression of the strength and importance of highway activities. Popular interest in highway affairs would be stimulated to a greater extent throughout the whole country than is possible by separate meetings, even though these might be more widespread. Each group would be enabled to carry forward its separate aims as heretofore, while at the same time projecting its influence for joint accomplishment. None would lose its individual identity, but every participating association would share in the more extensive publicity which would be justified by the size and far-reaching importance of the combined congress.

Details of the Plan—The plan would be to hold such a construction congress in a city properly provided with hotel and exposition facilities. The individual associations could hold their own meetings for the first three days in a manner that would not deflect in any way from the usual benefits derived from annual meetings by these individual associations. The program on the fourth day could include the combined activities of all the associations—a joint effort of the associations in which the outstanding leaders in the industry would take part. On the evening of the fourth day the construction congress banquet could be held, participated in by all identified with the various groups. On the following day the different associations could conclude the congress by holding either individual or group meetings. Such a combined congress, in addition to solving many of the problems and difficulties general to all groups, would focus the attention of the country on the industry and command for it the support necessary to coordinate the financial, contractural, engineering, material and equipment interests of which it is composed.

Proposal Already Approved—This proposal has been discussed by a few officials and representatives of interested organizations and the plan now submitted is the result of these joint deliberations.

The following associations have already expressed their willingness to cooperate in a congress in 1933, provided the details can be worked out: Associated Equipment Distributors, Associated General Contractors of America, Construction League of the United States, National Crushed Stone Association, National Paving Brick Association, National Sand and Gravel Association, Ready Mixed Concrete Association. Additional associations that would probably be willing to take part, but which have not as yet been approached, include the Asphalt Paving Technologists and the Truck Association Executives of America.

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Planning Manual in Demand

Many requests have been received for copies of the County Planning Manual presented at the Detroit Convention of the American Road Builders' Association.

This manual has been written with the active aid of the County Division Committee on Regional Surveys and Plans of which E. A. Griffith, chief engineer of roads, Allegheny County, Pittsburgh, Pa. is chairman, in collaboration with the National County Road Planning Commission of which Major George W. Farny is chairman. It is the result of several years extensive plan and studies. Mr. Griffith is the author of several planning papers including a detailed report of advance planning progress in Allegheny County presented at the annual convention of the Association last year.

The planning manual has been prepared for the purpose of avoiding waste in the counties and to provide a guide for an orderly program of county highway work.

Special plans have been prepared for Morris County, N. J. and Prince William County, Va. These plans provide a comprehensive scheme for the future improvement of county roads. Not only are roads for future construction designated, but a finance plan is set up to provide for their improvement.

New Equipment and Materials

Austin Announces New Convertible Shovel and Crane

A new ⅜ yd. tractor shovel and crane has been announced recently by the Austin Manufacturing Co., the manufacturing organization of the Austin Road Machinery Co., of Chicago.

This shovel is equipped with an 11 cu ft. capacity bucket of all-welded construction. One feature of the boom which is formed from two 12-in. channels is in the curved upper end to give greater clearance

Austin ⅜ yd. Shovel

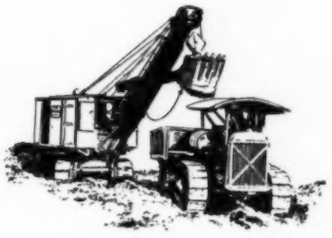
for the dipper handle. As a result the maximum dumping height is 17 ft. 10 in. with a boom angle of 55 degrees.

Since flexibility in operation is particularly important in a small shovel, considerable attention has been given to this point. The crawls are 10 ft. 6 in. in length and measure 7 ft. 8 in. from outside to outside in width, thus providing a very substantial base. Speeds as high as 4 miles an hour are possible on the road, although the machine's crawlers are not depended upon for transport over any great distance. The power plant is the McCormick-Deering model 20 industrial unit.

There are also many other mechanical refinements such as the extensive use of heavy anti-friction bearings, booster type clutches, brakes which are readily renewable, high pressure lubrication of all points and a greater degree of accesibility. Anti-friction bearings are extensively utilized on this shovel.

Another point of interest is in the interchangeability of all of the clutches. These clutches are of a standard tractor design so that repair parts are obtainable anywhere without difficulty. Cut gearing enclosed and running in oil is another refinement.

Another design feature which has been given considerable attention has had to do with increased portability. The shovel is provided with a mounting of rubber-tired wheels for quick transportation and tow behind a truck. With such a mounting it is possible to transport the shovel at a speed of 25 miles per hour from job to job. By utilizing the power of the crawlers and with suitable blocks it is possible to mount the shovel on its wheels in approximately 10 minutes and de-mount it in 5 minutes.



Five major conversions are possible to adapt the shovel for other types of work. A clam shell attachment; a 48-in. back filler for scraping earth into excavations; a ditcher attachment, ordinarily called the trench hoe or back hoe; the drag line and the crane, make up the convertible features. When converted as a crane the shovel will handle loads of approximately 3,000 lb. at a radius of 15 ft.

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New 6-Cylinder Truck Announced by White Co.

A new 6-cylinder truck of the most advanced engineering design, having a tonnage rating of 3 to 4 tons and an allowable gross weight rating of 18,000 lb., is announced by The White Co., Cleveland, O.

This new truck, known as Model 618, is capable of carrying a large pay load at a speed of around 35 miles per hour. It is adaptable for all around trucking purposes and is also especially suited for all kinds of public utility service.

It is powered with a White 6-cylinder L-head engine, 3¾ in. by 4½ in., with a counterbalanced crankshaft, seven main bearings and oil and air filters. A single plate wet clutch is used together with a heavy duty five speed transmission. Four wheel internal expanding hydraulically applied brakes are standard.

The model is offered in five wheel bases, shortest 136 in.; longest 206 in.; three of which have a frame 8 in. in depth, and two, 9 in. in depth; all frames being heat treated pressed steel channel type. A polished cast aluminum radiator shell and tubular core and crown fenders are used, presenting a distinctive and pleasing appearance. Steering is by cam and lever type. Starting and lighting, with battery ignition, are standard, together with 9.00 balloon tires on cast steel wheels.

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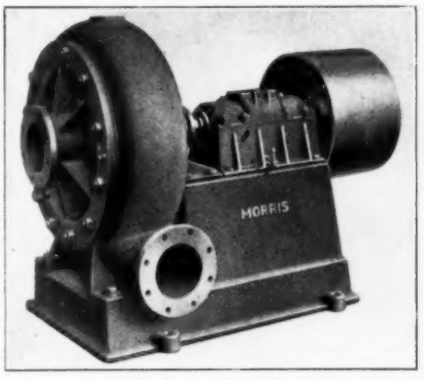
New Sand Pump

Morris Machine Works of Baldwinsville, N. Y., has supplemented its line of standard, medium duty, and heavy duty centrifugal dredging pumps with a new pump of simpler construction, known as the Type L sand pump. This unit has been developed as an inexpensive but rugged and troubleproof pump for handling sand, silt and other abrasive materials.

The parts of the new Morris Type L sand pump which are subject to wear, that is, the shell, impeller and suction disc, are heavily proportioned and made of hard semi-steel containing admixtures of nickel for resistance to abrasion and wear. The impeller assembly is designed for adjustments to take up wear. The pump parts which may require renewal after long service are designed to be inexpensive and quickly replaced.

The important requirement of eliminating all vibration is obtained in this new Morris design by the rigid connection between the casing and the frame, and also by the extra-large forged steel shaft sup-



Morris Type L Sand Pump

ported in a double enclosed bearing, consisting of two heavy duty steady bearings with a roller thrust bearing between.

These pumps are built in sizes from 4 to 12 in. and for either belt drive or for direct connection to driver.

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New 4-Cylinder Engine

Continental Motors Corporation, Detroit, Mich., has just announced another modern 4-cylinder engine of 74.83 cu. in. displacement for industrial application to be known as Y400, and its corresponding power unit as P410.

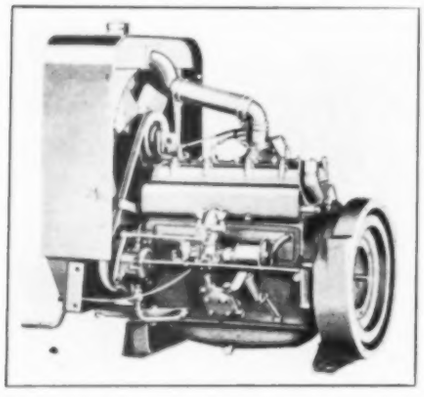
This engine is of 2¾ in. bore and 3 5/32 in. stroke and develops 10.75 hp. at 1200 r.p.m., the recommended governed speed, and 17.8 hp. at 2000 r.p.m.

For power needs in the lower ranges and particularly for low weight equipment of portable type, this engine weighing only 250 lb.—or 350 in power unit form, including carburetor, magneto, governor, fan, radiator, gasoline tank, controls, base supports and sheet steel housing.

The crankshaft has 3 bearings 1 9/16 in. diameter and is fully balanced in accord with Continental practice. Connecting rods are drop forged steel with lower bearings of 1½ in. diameter; white metal alloy being spun into the rod. The semi-steel flywheel will accommodate a heavy duty industrial clutch. Intake and exhaust manifolds on the left side of the engine are fully water jacketed; the thermo-syphon system affording efficient circulation. A carburetor of vertical type is supplied with the complete engine, equipped with an efficient air cleaner. A cen-

trifugal type gear driven governor, automatically lubricated, provides variable control. Oil circulation by a vane pump driven from the camshaft supplies pressure feed to camshaft bearings, crankshaft, connecting rods and gear case, maintaining 15 to 20 pounds pressure at 1400 r.p.m.

The power unit mounting is of the base type with a rear support angle attached to the flywheel housing, and a pressed steel front support. Radiator and gasoline tank may be mounted without using the usual power unit housing.



New Continental Engine

Provision is made for heavy duty clutch and power take-off. Stub shaft for direct drive connection may be readily bolted to the flywheel. Reductions, with or without clutch, or right angle drives, can be supplied on order.

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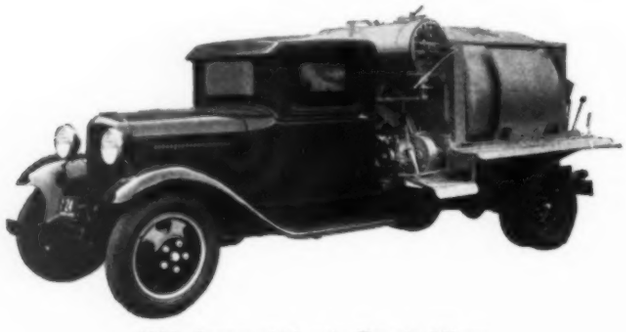
1932 Jaeger 1½ Yd. Truck Mixer on 1932 Ford Truck

A higher speed truck mixer for both the contractor and the commercial concrete plant is offered in the 1932 Jaeger 1 and



1932 *Jaeger 1½ yd. Truck Mixer*

1½ cu. yd. units of the Jaeger Machine Co., Columbus, O., mounted on the 1932 Ford chassis. The 1 yd. unit is furnished for 132 in. wheel base and is driven direct from the truck engine. The 1½ yd. unit is furnished with separate engine drive for 157 in. wheel base chassis.

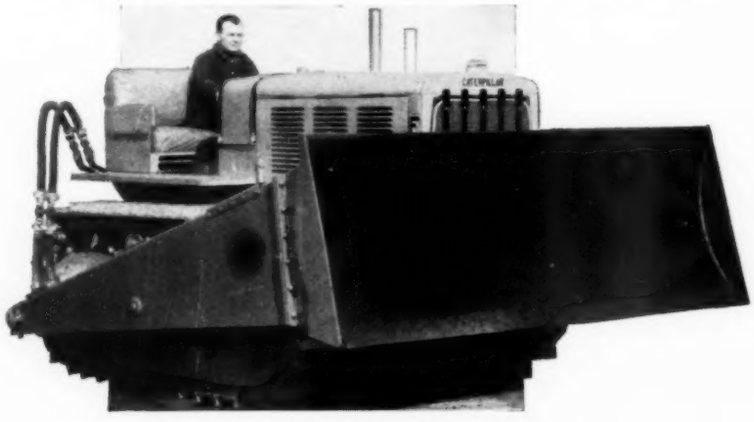
With the greater speed of the new Ford, these truck mixer units are intended for express service use by commercial concrete plants and for use by contractors on road widening and maintenance work, aprons, bridges, conduit, sewer, curb and gutter work.

New Blaw-Knox Bulldozer

A new type Blaw-Knox (Ateco) bulldozer has been brought out by the Blaw-Knox Co., Pittsburgh, Pa. This bulldozer is made for attachment to all sizes of tractors and has distinctly unusual design features. The power is hidden in the operating mechanism, being enclosed in the side arms, fully protected from dust and dirt—reducing maintenance cost and preventing breakdowns. The bulldozer bowl is curved, designed to lift and roll dirt, greatly reducing resistance to pushing The cutting edge is made of alloy steel to give the greatest possible resistance to abrasion and to retain its sharp cutting edge. The bowl is electrically welded, heavily reinforced, supported by two side arms and attached to tractor truck frame.

Another feature of the new Blaw-Knox bulldozer is its compact box type of construction, which allows the blades to work within close limits of the tractor. No part of this frame work extends beyond the rear of the tractor, the drawbar being left free and clear for the attachment of other equipment. This simplicity of this design and absence of frame work gives great accessibility to the tractor mechanism and maximum visibility to the operator.

The bulldozer is controlled by the tractor operator through the action of the double acting Ateco hydraulic pump, which with a single control holds the bowl with its cutting edge at any desired elevation. A movement of the lever actuated by one man control in one direction raises the bowl. Moving the lever in the opposite direction lowers the bowl. The pump actuates the hydraulic cylinder which is concealed in the side arm. Only four major parts are involved in the new Blaw-Knox bulldozer, providing for maximum simplicity and ease of installation or demounting. The bulldozer can be used in conjunction with other grading machinery, as the drawbar is free and clear at all times. There is a by-pass safety valve in the piston which allows the bowl to lift if it encounters large bowlders or other immovable obstruction. This saves breakage, distortion and repairs.



Blaw-Knox (Ateco) Hydraulic Bulldozer

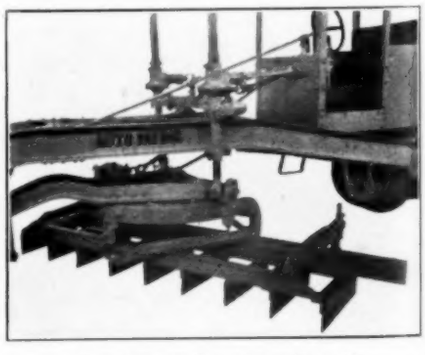
The range of adjustment of the cutting edge for raising above and cutting below track level has been determined by Blaw-Knox engineers as being the maximum to cover all practical operating conditions.

▼

Multiple Blade Attachment for Patrols

A multiple blade arrangement for auto patrols has been announced by the Caterpillar Tractor Co., Peoria, Ill. The multiple blade attachment is designed to cover a swath equivalent to that obtained by the use of a standard 12-ft. blade.

The attachment consists of nine short cutting blades of 8 in. x ½ in. cutting edge material 27 in. long mounted on a frame at right angles to a leveling blade of 8 in. x ½ in. cutting edge material 12 ft. long.



Attachment for Auto Patrols

Installation on "Caterpillar" auto patrols in the field may be accomplished by cutting only two rivets and replacing with bolts which are furnished. If at times it is desirable to use a regular blade for shoulder trimming, or the like, substitution is easily effected.

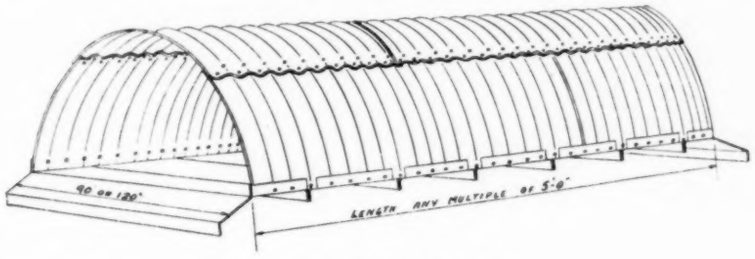
The attachment is angled slightly to the

right or left for operating position; just enough angle so that the path of each blade meets the path of the succeeding blade. In such operating position these blades have a very sharp cutting that rivals a scarifier for cutting the bumps, and it shaves the base, below the surface material.

Speeds of 6½ or even 10 miles per hour —without chatter—are now permitted. The long rear blade is adjustable and is placed at a level that is just high enough to trowel the surface material back in place in uniform thickness over the entire swath.

Part Circle Multi-Plate Pipe

To provide a strong drainage structure that will give adequate waterway areas without the headroom necessary for full-round pipe, the Armco Culvert Mfrs. Association, of Middletown, O., has recently developed a new product, part circle multi-plate pipe.



Part Circle Multi-Plate Pipe

The illustration shows the design of this type of construction with 5 or 3 gauge flat base plates each 30 in. wide, and with an apron plate at each end of the pipe.

The ends of the base plates are turned up 4½ in. so that the arch can be bolted to the base. (The corrugations are 6 in. from crest to crest and 1½ in. deep.) The sides of the base plate are turned down with a 4½-in. lip to give stiffness and ample strength to prevent buckling under ordinary shallow fills where this type of installation is used. The base plates are held together by the corrugated arch plates (by bolts through the end flanges). All plates, both flat and corrugated, are of Armco ingot iron.

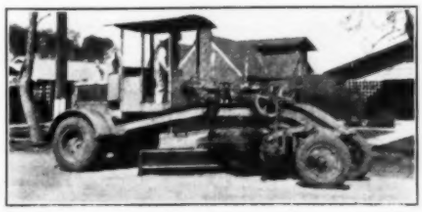
Part circle multi-plate is manufactured with 3, 4, and 5 arch plates which form spans ranging from 90 to 220 in. and in lengths of 5 ft. or multiples of that number (waterway area is equivalent to 60 and 84-in. and larger full-round). The arch plates are available in any of the three standard gauges, 3, 5, or 7.

Before announcing this product it was tested under conditions believed to be more severe than will be met in actual service. For the test one of the standard sizes, 120-in. base, 60-in. rise, with 5 gauge top and 3 gauge base, was used. The structure was erected on 9 in. of dry sand which gave a uniform but semi-fluid condition similar to conditions often found in streambeds.

Under a load of 76,025 lb. (of metal ingots supported by a simple timber platform contacting the arch at three points) the crown deflected a maximum of 1¼ in. with no apparent tendency to failure, either of the arch or the base.

Road Broom

The Speeder Machinery Corporation, Cedar Rapids, Iowa, manufacturers of Speeder shovels, cranes, draglines and trailers, is now manufacturing the Speeder road broom. This broom was formerly



Speeder Road Broom

manufactured in the Pacific Northwest and was known as the Owen road broom.

This broom has been used quite extensively in the Northwest territory for the past several years, particularly for gravel maintenance and oil penetration work. The broom is a replacement unit for the cutting edge on any standard one man maintainer or pull type grader. The mold board and cutting edge are removed and the broom inserted instead. These brooms vary in width from 8 to 14 ft.

This broom is recommended particularly for gravel maintenance where the roads are subject to chatter and washboard bumps. The broom is composed of steel wires about 18 or 20 in. long which will give when striking some immovable object such as a deeply imbedded stone, thus eliminating the ridge.

For oil mix work the broom is stated to give more penetration because of the greater mixing ability of the broom, due to the springing action of the individual wires.

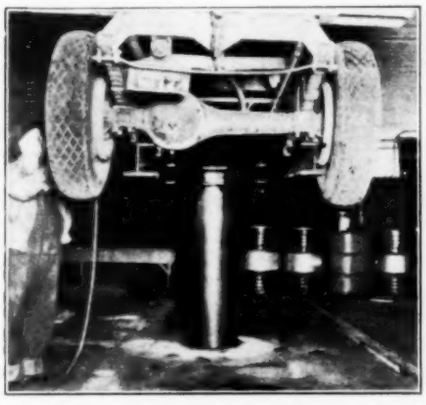
Another advantage of the road broom is the fact that it does not become dull. No replacement of the broom is necessary until it is completely worn out. The life of a broom in most cases is estimated at about one complete season.

The broom is also built in a complete unit which it is not necessary to place on a grader chassis.

Truck Lift for Road Equipment Garages

This illustration shows a county road building truck on lift in the garage of the Jackson County Highway Department at Independence, Mo., ready for under-the-truck service. This lift, a product of the Curtis Pneumatic Machinery Co., 1935 Kienlen Ave., St. Louis, Mo., is made in both 6 and 10-ton capacities, and handles even trucks of unconventional design. This lift is operated by air from the garage air compressor.

The lifts are oil locked at all positions, going up or coming down, therefore are safe at all heights, even though the air pressure drops or is disconnected entirely. The load can not be lowered even with all of the air exhausted from over the oil until the operator in addition releases the oil locked valve. The lowering speed is absolutely independent of the operator and even if the air line should become disconnected, the load will not lower until desired and then only at a predetermined, safe speed.



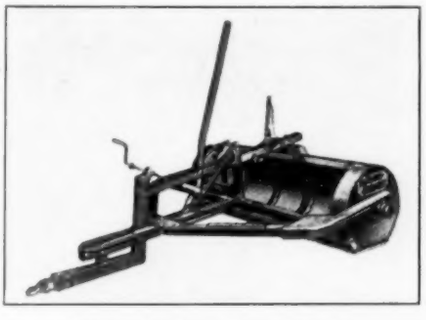
Curtis Lift in Garage of Jackson County Highway Department

The grease packed gland ring (patent applied for) prevents sand, grit and foreign matter from getting into the cylinder which therefore permits trucks to be washed on the lift when desired.

Roll-Over Scrapers

The La-Plant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa, has acquired the license to manufacture automatic roll-over scrapers under the Reynolds patents No. 1642826 and No. 1843339, and all La-Plant-Choate scrapers of this type are manufactured under the agreement.

These scrapers are built in five sizes with the following capacities: 18 cu. ft.—



Automatic Roll-Over Scraper

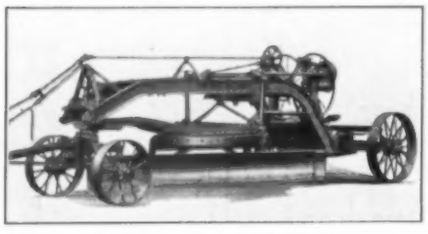
22 cu. ft.—27 cu. ft.—42 cu. ft.—and 56 cu. ft.

These one-man operated automatic scrapers have a simple tripping mechanism which allows the scraper to be tripped while going forward or backward. The scrapers are equipped with a self-cleaning latch on the trip which automatically en-

gages itself, permitting the loaded bowl to be slid backward any distance without revolving. By a single pull on the trip lever rope, this latch will disengage and permit the bowl to be rotated either backward or forward and dumped. When the load has been dumped, this same latch holds the bowl in the dumping position, thus permitting the bottom of the bowl to be used to bulldoze the pile of earth into the desired position by backing up or to spread the earth in a layer when pulling forward.

New Grader

A new grader designed for use with the Caterpillar Fifty Tractor has been brought out by the Caterpillar Tractor Co., Peoria, Ill. The grader is of the leaning wheel type, with a 12 ft. blade. Its weight without scarifier is 9,360 lb. The grader is stated to allow a bank cutting 9 ft. high at an angle of 20 degrees off perpendicular, and to have a blade range that gives a side reach of 62 in. outside of rear wheel for shoulder work, when the standard blade



Caterpillar Fifty Grader

is set at 45 degrees horizontal angle. A greater reach is possible by applying blade extensions.

Some of the features of the new grader are: Entire lifting mechanism mounted on anti-friction bearings; lift arms, shafts and important forged parts are heat-treated; bronze lift gears adjustable to six points of wear; extensible lift links with ball-and-socket connections and shims for take-up; compensating blade lift springs; axle spindles chrome nickle heat treated steel; tapered roller bearings, cork seals and metal guards in all wheels.

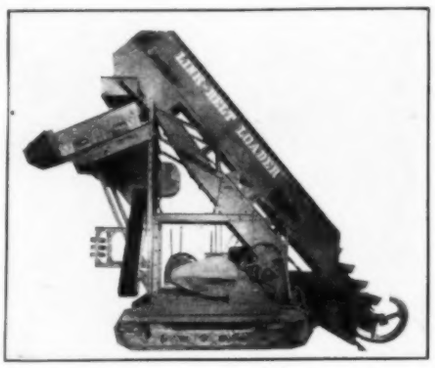
1932 Link-Belt Loader with Vibrating Screen

The Link-Belt Co., 2045 W. Hunting Park avenue, Philadelphia, Pa., has announced the 1932 model Link-Belt vibrating screen loader for sand, gravel, coke and coal, etc.

Among the improvements that have been made is the use of a mechanically-vibrated screen of the Link-Belt positively-driven type, the amplitude of vibration, or throw of the screening surface, being set at the factory, before loader is shipped, to vibrate the material gently, yet intensively and positively, over the entire screening area, and screen it clean.

The new screening arrangement provides greater clearance (10%) under the chute to truck. With the positive-drive screen, the inclination of the screening surface can easily be varied on the job, between 18° and 25°, to suit the work. Cantilever leaf springs maintain the screen box at a constant angle, being adapted for the circular motion produced by the action of the eccentric, positive-drive. The screen bearings are of the self-aligning spherical roller bearing type.

The entire loader is under the complete



1932 Model Link-Belt Loader

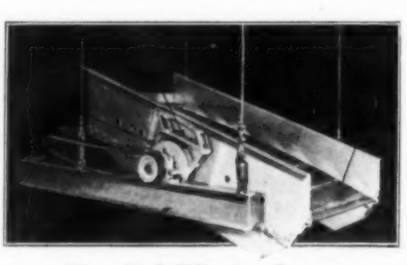
control of the operator on a large roomy platform, all operating levers being within easy reach. The bucket elevator capacity is 1¼ cu. yd. a minute, with uniform feed, the foot of the loader being equipped with an improved helical steel ribbon feeder, which clears a path 7 ft. 7 in. wide, delivering the material to the buckets gently and uniformly.

A three-speed transmission gives the crawlers a speed of 30-ft. a minute, or 66-ft. per minute, in the digging direction, and 27-ft. per minute in reverse. The driving machinery runs in oil and is enclosed in a dust-tight housing.

New Vibrator Screen

A unique quick-change screen panel is probably the outstanding feature of the new vibrator screen announced by Stephens-Adamson Mfg. Co. of Aurora, Ill. The screen is of the positive vibration type in which the rigid screen body, with one or more decks, is given a vibration of fixed amplitude by the rapid "throw" of a heavy eccentric shaft.

The vibrator mechanism is a self-contained, factory adjusted unit. It consists of an eccentric shaft, adjustable balance



New S-A Vibrator Screen

wheels, heavy SKF, double row ball and roller bearings, labyrinth grease seals and a tubular cast steel housing.

The outstanding features of the new screen are: 1—quick-change, reversible screen panels; 2—stretching levers for screen cloth; 3—stabilizer mounting; 4—added protection for bearings; 5—cushion springs for suspension cables.

The new quick-change panel is a full size piece of screen cloth with a stiff structural steel angle brazed to each end. The panel is placed by sliding into position until the ends of upper cross angle drop into sockets in side frames. Stretching levers are slipped on the ends of lower angle and tightened. Installation tests are stated to indicate that two men can change or reverse a panel on any deck in about 15 minutes.

The stabilizer unit, made up of parallel arms, holds the screen body at the desired screening angle without the use of corner balancing springs or bumpers. The unit connects screen body and subframe in such a way that the screen is free to vibrate and yet is held at a given angle. It is claimed that the elimination of bumper springs reduces sub-frame vibration considerably. By loosening two mounting bolts, the operator can change screening angle or tilt screen body clear of chutes for panel changes.

Extra bearing protection has been provided in the form of cast flywheel housings with overlapping drip guards. These prevent gritty water from reaching the bearing seals and the screen can be used for washing or rinsing.

Leakage of vibration to building is reduced by suspending the subframe from four corner cables. New cushion springs for these cables reduce the leakage still further.

Each screen is furnished with a vibrating unit assembled to suit the material handled. Eccentric shafts and drives for different amplitude and frequency of vibration prevent blinding or excessive bouncing of material.

New Flooring for Bridge

A new flooring for bridges brought out recently by the Truscon Steel Co., Youngstown, O., is only 3 in. thick and weighs but 50 lb. per square foot. For this flooring the steel Teegrid slab (copper-bearing) is manufactured from structural tees placed side by side with their flanges welded together and with triangular cross bars pressure-welded into the top of the stems of the tees. The standard spacing of the cross bars is 4 in. centers. The top surface of the cross bars and the stems of the tees form a

Teegrid Flooring

steel armored wearing surface. The space between the stems of the tees and beneath and around the cross bars is filled with concrete. In the resultant slab, the steel and concrete are utilized to resist compression and shear stresses; the steel to resist tension stresses.

The steel Teegrid slabs may be 4 ft. wide, or less, and any desired length. Manufacturing standards provide for an

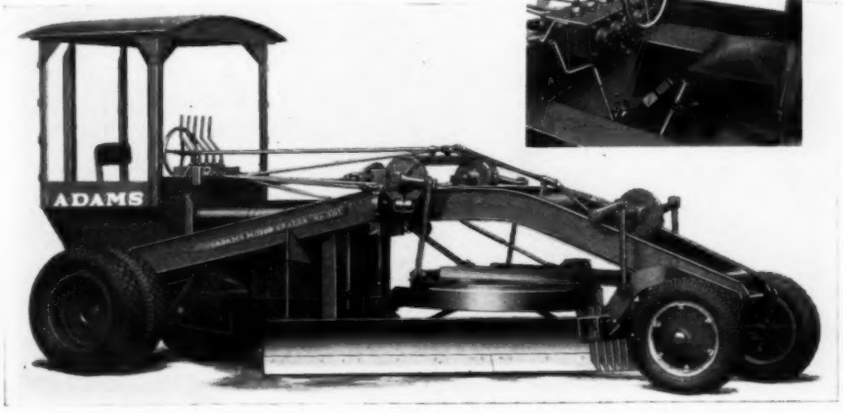
arc weld 2 in. in length and located between flanges of the tees at the ends of the slab and midway between each support. The slab is therefore stable for handling and shipping. The weld provides a positive connection between tees at mid-span, assures lateral distribution of loads and permits calculation of the Moments of Inertia, "I," of the slabs in a plane at right angles to the tees.

The steel Teegrid slabs are secured to their stringer supports by plug welds, bolts or rivets. Shop holes are provided in the slab for these attachments. When the slabs are erected, they are filled with concrete which is struck off level with the top of the stems of the tees and the cross bars, thus providing a steel armored wearing surface. The concrete may be poured to a greater depth, or any other standard material used for a wearing surface.

Adams Announces a New Motor-Controlled Motor Grader

A new motor grader with power operated controls is announced by J. D. Adams Co., Indianapolis, Ind., as an addition to its line of motor graders which includes hand-operated models furnished with McCormick-Deering and Case tractors.

This new machine is powered by the McCormick-Deering I-30 tractor—a new and improved product of the International Harvester Co. with new features and increased power.



Adams Motor Grader 301

Instant control, quicker adjustments and more efficient operation are the advantages claimed for the motor controls on this new Adams Motor Grader, known as No. 301. From his comfortable cushioned seat, the operator has a clear view of both ends of his blade and makes all adjustments quickly and practically without effort by means of the convenient control levers in front of him.

Power for operating the controls is taken from the front of the tractor and passed through enclosed reduction gears to the control box at the cab. Here a series of heat treated gears, running in oil on anti-friction bearings, transmit the power to the various control shafts. Very little power is required to operate the controls. All of the control mechanism including knuckles, is machine-finished for smooth operation and long life.

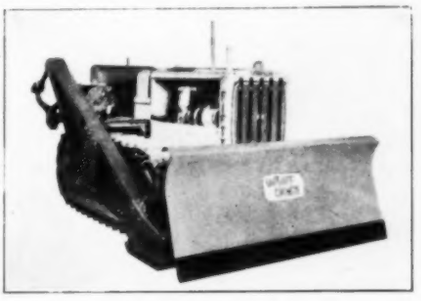
The operator's seat may be tilted sidewise out of the way, is adjustable backward and forward to suit the operator, and is mounted on a spring suspended platform which absorbs road shocks. Gear shift lever, throttles, clutch pedal, foot brake pedal, and hand emergency brake are all conveniently located. The cab may be fitted with canvas curtains or wooden enclosure which give the operator complete protection in cold or wet weather.

The machine is available with 10, 12, 14, or 16 ft. blade, with or without scarifier, and with dual pneumatic tires on the rear or Adams Tandem "Four-Wheel" Drive.

New La Plant-Choate Bulldozer

A new bulldozer having a double acting jack which enables it to be forced into or out of the ground under pressure, has been brought out by the La Plant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa. This bulldozer has an extreme high lift of 30 in. above the ground level, and it is stated the blade can be forced below the ground line to the extent of 16 in.

The blade is made up of one-piece heavy rolled steel plate, bent over at the top to form a channel, and heavily reinforced by eleven angle-iron ribs hot-riveted to the back of it. A heavy bent plate at the bottom of the blade reinforces the cutting edge. Riveted to this plate, both on top and bottom, are cast steel reinforcement brackets. The cast reinforcement on the top of this plate holds the strut arms which brace the blade against the main frame cross beam, forming a perfect bridge truss girder construction.



Hylift Bulldozer Mounted on Caterpillar Fifty

A cast steel shoe, with a 10 in. wide removable crucible steel sole is fastened to each side main frame member. This shoe can be quickly adjusted, both front and rear, to permit cutting at any level desired. This adjustment of the shoe also compensates for wear on the cutting edge. The entire shoe can be lifted and fastened in the clear for bulldozing work in rock and similar material where shoes are not desirable.

The bulldozer is operated by hydraulic control, the power for this being obtained from a simple La Plant-Choate rotary gear pump attached to the tractor power take-off. This pump runs constantly in oil, thus minimizing any chance of wear. The control valve is bolted directly to the pump and contains the oil by-pass for use when the jack has reached its full extremity on the raised and lowered positions. Positive leverage is obtained by means of lever arm linkage which transmits the power from the jack to the bulldozer main frame. Enough power is obtained to force the blade into the ground in the most stubborn material, and the positive control enables the tractor operator to secure an even, level cut when desired.

New Maintainer

A new maintainer, known as the Burch Undr-Truk Maintainer, has been announced by the Burch Corporation, Crestline, O. As the name suggests, this new maintainer unit is swung below the truck. It may be used with any truck and if desired, any number of trucks may be equipped with the simple fixtures to which the chains are attached, so that the same maintainer unit may be used with any truck that happens to be free for the job.

Burch Undr-Truk Maintainer

The fixtures for attaching the chains are bolted permanently to the truck body, and do not in any way interfere with the use of the truck for other jobs. Attaching the maintainer to the truck takes but a couple of minutes as all that is necessary is to run the truck onto the maintainer platform and hook up the chains. A few turns

of the crank raises the maintainer clear of the road and the truck is on its way to the job, traveling at normal traffic speed.

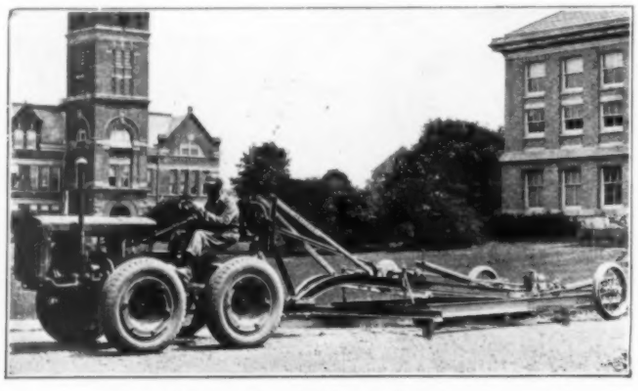
Arriving on the job, the maintainer goes into action without a moment's delay. Blading the material four times at one operation, the seven blades are stated to redistribute the surface material evenly and compactly over the road, leaving a smooth, compact surface. Regulation of pitch and of the pressure being applied by the maintainer is simplified by placing the two control levers within easy reach of the driver's seat. Culverts and other obstructions are easily cleared without loss of time. It is strictly a one man job.

For the average road, the regular width of the maintainer, extending but little beyond the truck, is sufficient to work the surface thoroughly with one trip in each direction. For wider roads, extension blades are provided, which makes possible the working of the full half of the road.

New Four Wheel Drive Tractor

The Massey-Harris Co., Inc., Racine, Wis., recently introduced a four wheel drive industrial tractor.

Spade lug steel wheels are available for conditions where the going is heavy as in wet soil, marsh land, clay, gravel and rough ground where positive traction is needed.



Massey-Harris G. P. Tractor

This tractor develops a speed of 2¾ miles per hour in low, 4¼ m.p.h. in intermediate and 9 m.p.h. in high. Reverse speed is 3¼ m.p.h.

The tractor is furnished with Twin Disc clutch and Massey-Harris oil flushing type of air cleaner. The wheel base is 52½ in.; width of tractor, 50 in. to 70 in., depending on wheel and tire equipment desired.

New Series of Drag Scrapers and Slackline Cableway Machines

From Sauerman Bros., Inc., 488 S. Clinton street, Chicago, comes the announcement of a new series of drag scraper and slackline cableway machines, designated as the Sauerman "Utility" machines, priced much below the general prices that have prevailed in the past fo. excavators of similar capacity and range of operation, has been announced by Sauerman Bros., Inc., 448 South Clinton street, Chicago, Ill.

The "Utility" machines are being manufactured in a number of popular sizes, whereas the main line of Sauerman scraper and cableway equipment will continue to be manufactured in a large range of sizes to meet capacity requirement up to 600 cu. yd. per hour, and for any length of haul up to 1,000 ft. or more.

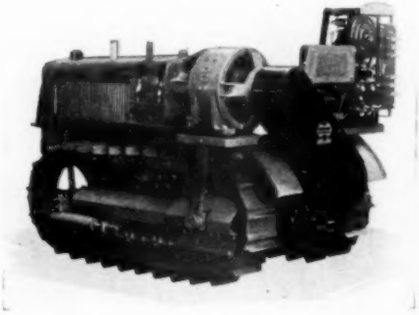
The "Utility" slackline cableway excavators are offered with four different sizes of buckets—of 9, 13, 20 and 26 cu. ft. capacity—and with operating spans of 300, 400 and 500 ft. The machines are divided into three series—gasoline-driven, electric-driven and belt-driven. The "Utility" bucket embodies several new features of construction tending to lighten the weight and increase the strength. Among these features are a rugged structural steel bail and a welded back. Another valuable detail of the bucket is its renewable, reinforced bottom. The carrier is equipped with alloy steel track sheaves. The mast-blocks are the long-life "Durolite" steel blocks. The power units are of rugged construction with semi-steel drums of large diameter and liberal rope capacity, semi-steel side stands, steel gears provided with ball bearings, steel shafts accurately turned and polished. The hoists are mounted on rolled steel bed-frames of one-piece box construction. The gasoline engine or electric motor furnished for each size of hoist is more powerful than formerly specified for machines of similar rating.

The "Utility" drag scraper machines come in five models of gasoline-driven machines, and a like number of electric-driven and belt-driven machines. The buckets used are Sauerman "Crescent" scrapers of 9, 13, 20, 26 and 40 cu. ft. capacities.

Sauerman Tautline Cableway with Traveling Head and Tail Towers

A New Tractor-Mounted Welder

A recent development in welding machines is being announced by Schramm Inc. of West Chester, Pa. This new welder is of a type that can be mounted on the framework of any standard make tractor and operated by "V" belt drive from the rear power take-off. Similar to the Schramm compressor mounting, the welder is located alongside the driver's seat on a removable sliding frame. Control panel is on the side opposite from welding unit.



Schramm Tractor Mounted Welder

This unit is of the same type used in the Schramm portable engine-driven welders—a single arc, variable voltage design. Sizes, for mounting on tractors of sufficient hp. rating, include 200, 300, 400 and 600 amperes. The welder mounting does not affect the pulling or towing feature of the tractor drawbar.

HIGHWAY MILEAGE IN PORTUGAL—In 1930 Portugal reported highway mileage as 11,807, divided as follows: 11,129 miles of macadam, 651 miles os asphalt surfaced, and 27 miles of granite blocks.